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RESEARCH PROFILES UNIVERSITY OF APPLIED SCIENCES SCHMALKALDEN 2017 ISSUE

SCHMALKALDEN UNIVERSITY OF APPLIED SCIENCES

RESEARCH PROFILES
UNIVERSITY OF APPLIED SCIENCES SCHMALKALDEN

2017 ISSUE

Research Profiles of University of Applied Sciences Schmalkalden
2017 Issue

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RESEARCH PROFILES

UNIVERSITY OF APPLIED SCIENCES
SCHMALKALDEN

2017 ISSUE

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Dear reader,

Prior demand has been very high, and in recent years has had a large impact on the research field of the University of Applied Sciences in Schmalkalden. A new and revised edition of the Research Profiles was therefore more than justified. You now have the results in your hand.

Scientific work and research remain the driving force of innovation. Research and Transfer are competitiveness factors. Research and Transfer form perspectives in the economic context as well as in education of students. Research and Transfer enhance the attractiveness of the enterprise and the university as well as their reputation. With this background, the collaboration between companies and the university has a special significance. Politics, business and academia are urged equally to make their contribution to the improvement of cooperation between science and industry. These Research Profiles are an important and appropriate step in this direction. The aim is to enhance the intensive interaction between business and science.

These Research Profiles inform you about special scientific work areas – and the reasons why research and transfer with the university are worthwhile.

The research focuses have a special significance for strengthening the competitiveness within the University of Applied Sciences Schmalkalden. A clearly defined orientation of the content of research priorities contributes to outwardly visible profile of the university. The two research focuses of the university are "Adaptive Signal Analysis" and "Product Development Toolmaking".

Research activities and research interests are in line with the economy of the region and the technology and research structure. Applied research for and with the region provides perspective, but also poses immense challenges. If this is successful, recognition of the region is certain. With competence comes confidence, and with confidence real opportunities for support increase through third-party funds, an important perspective for research funding.

Personal scientific and applied and/or industrial research at the University of Applied Sciences becomes significant when they find out about the work areas of colleagues. Much is probably still unknown to them and will hopefully surprise them in a positive way.

Please familiarize yourself with our offerings. Contact the team or colleagues directly when you notice tasks for us where we can support them or your company.

We hope reading this inspires you and look forward to your inquiry.

Prof. Thomas Seul
Vice-Rector for Research and Transfer

Dear entrepreneurs, dear ladies and gentlemen,

Research at the University of Applied Sciences Schmalkalden does not take place in an ivory tower. Take our word for it!

My main task as consultant of Research and Transfer is maintaining the interface between you and the university. On request, we advise, initiate and coordinate research cooperation with you. Close contacts in the regional economy are particularly important to us. As a university campus, we have easy access to all contact persons. We practice our applied research and practical orientation.

We especially have very good experience with collaborative research projects of the Thüringer Aufbaubank, but also with projects of the Federal Ministry of Education and Research, such as for example with the public funding programmes "FHProfUnt" and "Ingenieurnachwuchs". Of course, we will also gladly develop projects which you directly commission us.

Experience shows that the personal engagement of all partners plays an essential role for a successful research project. You can find a number of good examples for this within these Research Profiles, which represent a wide range of selected research fields which we offer at our university.

I would be glad if our leaflet is able to raise your curiosity about us and our activities. Do not hesitate to contact me if you should have any questions or concerns. Of course, I would welcome the opportunity to visit you at your company, to establish common contacts and to animate research collaborations.

Sincerely yours,
Sandy Korb

Profile

The interdisciplinary research focus of the Faculty of Computer Science and Electrical Engineering was founded in 2003 and consists of two research groups:

"Computer-aided Intelligence"
Head: Prof. Dr. rer. nat. Martin Golz

"Embedded diagnostic systems"
Head: Prof. Dr.-Ing. Andreas Wenzel

Previous research projects were dedicated to a wide range of tasks in the data and signal analysis and pattern recognition in medical and technical fields of application. In addition, various problem-specific software and hardware solutions have been developed. The research focus operates five laboratories where scientific studies can be made. The reference projects listed show the range of recent activities.

Research Areas

- Sensor Signal and Biosignal Analysis
- Image, Video and Audio Analysis
- Pattern Recognition: Classification, Cluster Analysis, Approximation, Prognosis
- Non-linear Optimisation
- Knowledge Representation, Expert Systems
- Data Mining, Big Data
- Data Visualisation
- Modelling and Simulation
- Embedded Systems, Embedded Intelligence

Contact

Research Focus
Adaptive Signal Analysis

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Staff and facilities

- 2 Professors
- 5 Doctoral candidates
- 2 Scientific staff
- 3 Post-Doc staff
- 2 Laboratory engineers
- Students, Interns

1. Laboratory for "Embedded Systems & Mobile Computing"
   Hardware and software development for embedded systems
2. Laboratory for "Experimental signal analysis and pattern recognition"
   Analysis / characterization of biological and technical signals
3. Laboratory for "Human factors: Driving simulation"
   Studies on sustained attention of drivers; device tests
4. Laboratory for "Human factors: Usability / Eyetracking"
   Suitability of user interfaces; gaze tracking
5. Laboratory for "Human factors: Vigilance tests"
   Studies on vigilance and distraction; test comparisons

Transfer projects

- Characterisation of vehicle dynamics
  Adaptive pattern recognition, sensor signal processing, expert system, validation
  Clients and Partners: a medium-sized business
- Remote diagnostics of a compact water treatment plant
  Prognosis, pattern recognition, embedded systems, modelling and simulation
  Client: Federal Ministry for Economics and Technology
  Partner: Three medium-sized enterprises, a research facility
- Mobile data collection for a purchasing system
  Mobile computing, user interface, database systems
  Clients and Partners: a medium-sized business
- Analysis of vehicle tracking based on outside camera recordings
  Video analysis, pattern recognition, mobile computing
  Clients and Partners: a medium-sized business, Singapur
- Surface and imprint inspection at production speed
  Industrial image processing and real-time pattern recognition
  Client: Federal Ministry for Economics and Technology
  Partner: Two medium-sized enterprises, a research facility
- Optimisation of routing in transport infrastructure planning
  Computer graphic modelling, non-linear and multi-criteria optimisation
  Client: Federal Ministry for Economics and Technology
  Partner: a medium-sized business
- Error diagnosis in a vehicle database
  Big Data, Data Mining, Multi-classifiers, expert system
  Clients and Partners: a medium-sized business

"Human Factors" research projects

- Analysis of biosignals at high driver fatigue
  Biosignal processing, pattern recognition, computer-aided intelligence
  Client: Federal Ministry of Education and Research
  Partner: Two research institutions, a medium sized company, USA
- Development of a oculomotor vigilance test
  Biosignal processing, pattern recognition, computer-aided intelligence
  No client (self-financed)
  Partner: A research facility
- Modelling of light influence on the circadian rhythm
  Modelling and simulation, non-linear optimisation
  No client (self-financed)
  No partner
- Cardiovascular dynamics in several days of laboratory experiments
  Biosignal processing, pattern recognition, computer-aided intelligence
  No client (self-financed)
  No partner
- Diagnostic support of fall risk of senior citizens
  Posturography, gait analysis, biosignal processing, computer-aided Intelligence
  No client (self-financed)
  Partner: two research facilities
- Phonetic analysis for the assessment of human factors
  Audio signal collection and analysis, pattern recognition, computer-aided Intelligence
  No client (self-financed)
  Partner: A research facility
- Analysis, optimisation and evaluation of layer deployment plans
  Integer linear optimisation, evolutionary strategies
  Clients and Partners: a medium-sized business, USA
- Recognition of driver's condition based on driving data
  Adaptive signal processing, pattern recognition, computer-aided intelligence
  Clients and Partners: a medium-sized business

Research projects

- Evaluation of driver assistance systems
  Driving simulation, adaptive data analysis, expert rating, neurophysiological reference standard
  Clients and Partners: Large enterprise, USA
- Innovative paradigms transfer in road construction
  Computer graphic modelling and driving simulation, adaptive data analysis
  Client: Federal Ministry of Traffic, Construction and City Development
  Partner: Two medium-sized enterprises, a university institute, a University of Applied Sciences
- Detection of faults in fibre optic signals
  Correlated, optical time domain reflectometry, adaptive pattern recognition, validation analysis
  Clients and Partners: a medium-sized business
- Vehicle detection with a geomagnetic sensor
  Sensor signal processing, pattern recognition, validation analysis, embedded systems
  Clients and Partners: a medium-sized business

"Embedded diagnostic systems" project

- Research Group for Flexible Manufacturing Technologies (Power Moulds):
  Condition diagnostics in injection moulding dies using embedded systems
- Automatic classification of sleep and anaesthesia EEG through self-learning processes
  Polygraphics recording technique in the laboratory
  "Experimental Signal Analysis"
- Model-based software design of an optimised control system for small electric drives
- Design and development of embedded test software for ultrasound therapy device
- Development of a module for expanding EEG classification for therapy support (Biostress)

Profile

The research focus of product development toolmaking combines expertise of professors from the Faculty of Mechanical Engineering.

Symbiotic effects are formed through interdisciplinary priorities production and developmental based know-how supports the development process and allows examination of an object from different points of view.

The motivation of the research focus includes the approach: "From idea to product". A product is the result of activities and processes. Within the research focus this result can be a product and/or a complex tool.

Core competencies

Prof. Dr.-Ing. habil. Annett Dorner-Reisel conducts research e.g. in the field of tribology of carbon-based thin-film systems in biodiesel and heterogeneous fuel mixtures. The objective of the project is the systematic study of friction and wear behaviour of DLC coatings in various grades of diesel and gasoline with portions of biofuels and under different temperatures. Various wear test stands are used for this purpose.

Prof. Dr.-Ing. Thomas Seul, whose appointment area is manufacturing technology and tool design, supports the research focus through advanced product development skills in the field of medical technology and related processes and procedures in tool making.

Contact

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The use of simulation and design programs is a core competence of Prof. Dr.-Ing. Hendrike Raßbach.

The application is used, among other things, for:

- Design, simulation, animation as part of the Digital Prototyping
- Forming simulation of anisotropic materials
- Static and dynamic 3D deformation measurement (ARAMIS system)
- Modular qualification program "Structural Mechanics for designers and product developers"

The core competencies of Prof. Dr.-Ing. Harald Vogel are used in the field of machining and thermal ablation. Associated with this, for example, is the assessment of the functional properties of complex cutting tools by means of cutting force and acoustic emission analysis during machining. Based on these analysis valid statements can be gained about wear behaviour, concentricity (unbalanced) or tool breakage.

Abrasive methods include electrical discharge cutting, die-sinking EDM and erosive drilling. The goal of the work is solutions for producing filigree structures with high aspect ratio. This is achieved through targeted adaptation of the processing parameters and an optimised machining strategy.

In addition to contributed core competencies of the individual business areas, the performance range of the research also in particular includes the resultant cross-cutting issues.

Staff and facilities

The research focus of product development/tool making consists of the four participating professors and their associated laboratories.

Please refer to the information on individual laboratories for details on the equipment:
Prof. Dr. Ing. habil. Dorner-Reisel . . . . . Page 27 Prof. Dr. Ing. Seul . . . . . Page 30

Selected reference projects

Tool calculation/optimization
Computer simulations based on the finite element method for determining the insulation displacement contact performance, taking into account the resulting dynamic forces.

Cooperation project with the GFE - Society for Research and Development - Schmalkalden.

Projects in the field of service life determination for coated tools, for example, high performance cutting, forming tools.

Accompanying a tool development and support of FEM simulation and prototyping.

Project objective: Producing electronic components in which metallic conductor tracks are applied to injection moulded plastic carrier.

- MID (Moulded Interconnect Devices) research project which was carried out with the affiliated partner Thüringische Weidmüller GmbH
- Laser structured and metallized plastic component, which has been assembled using SMD
- Operational MID demonstrator

Profile

Whether modern vehicles or new automation solutions - the share of electronics and especially software components is constantly increasing. With the continued miniaturization and new possibilities for networking, the complexity of such systems keeps growing.

To deal with these trends, our laboratories are equipped with modern equipment to support the model-based design of intelligent, real-time capable control and regulation systems for various applications. Our range extends from modelling and simulation to realization of prototypes in the form of embedded systems.

Research Areas

- Intelligent Control and Regulation Algorithms
- Distributed Embedded Systems
- Rapid Control Prototyping
- Functional Safety

Contact

Faculty of Electrical Engineering
Laboratory for vehicle electronics and automation technology

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Profile

The institute for utilities industry – directed by Prof. Dr. Hubert Dechant - is an internal institute of the University of Applied Sciences Schmalkalden. The Institute focuses on water supply and sewage water disposal from an economic perspective.

Due to historical reasons the water supply and sewage disposal systems are largely technical in nature. The prior focus is supplemented by the economic perspective. Against this background, it is also legitimate to consider water as a market, something which already stands out today in some countries.

There is a transfer of knowledge between research and teaching thanks to the collaborations and partnerships with companies in the regional and national economy.

Key partners of the Institute are the RWTH Institute for Water Research (Mülheim an der Ruhr), the auditing company Rödl & Partner with the area municipal services and the engineering firm Dr. Lopp (Weimar).

Research Areas

- Conducting efficiency studies of the Thuringian water supply
- Conducting efficiency studies of the Thuringian sewage disposal
- Creating economic feasibility studies of water supply systems and wastewater treatment plants
- Creation of drinking water balance sheets
- Evaluation of companies in the water sector

Contact

Institute for utilities industry

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Profile

In the laboratory for Communications Technology, parallel to lectures for study courses in Information Technology (BSc) and Electrical and Computer Engineering (Master of Science), laboratory courses and practical exercises are conducted. We mainly focus on the use of Matlab / Simulink. In addition, the laboratory for research projects is also used. Students have the laboratory at their disposal for the intended curriculum in project work and the final paper (Bachelor or master thesis).

Among other things, seminars and exercises are offered in the laboratory for the following lectures:

- Communications Technology I and II
- Systems for Communications Technology
- System Theory and Signal Processing
- Digital Signal Processing (WPF)

Research Areas

- Digital Transmission Technology
- Digital Signal Processing
- Software Defined Radio (SDR)
- Communication Networks
- Quality of Service

Contact

Faculty of Electrical Engineering
Communications Engineering
Laboratory

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Profile

The laboratory is headed by Prof. Dr.-Ing. Werner Rozek of the Faculty of Electrical Engineering.

Prof. Rozek teaches Process Instrumentation / Image Processing / Navigation, bus systems in vehicles, electromagnetic compatibility, electrical engineering, and signals and systems.

In seminar-lectures, supplemented by exercises and internships, the students gain broad technical engineering expertise, practical skills and abilities.

Project, bachelor and master theses, are used for expanding participant's knowledge.

Current topics of holistic IT-5D security technology developed at the University of Applied Sciences are elaborated based on KANBAN and development equipment used in industry. This leads to the development of pre-competitive software- and hardware-based products such as, Transparent Security Gateway, Security Stick (SSK) developed Secure Headset SeTec.

Research Areas

- Network Security
- Communications, file and folder protection, authentication of persons or devices and data
- Verification of the IT-5D technology
- EMV and bus systems
- Toll system

Contact

Faculty of Electrical Engineering
Laboratory for IT Security in 5D

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Profile

The Laboratory for Microscopy and Material Diagnostics headed by Prof. Dr.-Ing. Horst Schäfer belongs to the Faculty of Electrical Engineering. His area of appointment covers physics and materials and components of electrical engineering.

In the lab, basic internships are carried out for all engineering courses.
Otherwise, the main focus of Prof. Schäfer is in the area of semiconductor physics.

Research Areas

- Damage diagnostics and cause study
- Light and electron microscopic surface representation
- Material diagnostic studies
- Nondestructive material testing

Contact

Faculty of Electrical Engineering
Laboratory for Microscopy and Material Diagnostics

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Profile

For about 10 years, there has been a collaboration with the Institute of Physiology of the Medical Faculty of the University of Jena in the field of ion channel research.

In order to better understand the interaction of neurotransmitter and receptor on the ion channels, which is essential for the origin and transmission of impulses in nerve cells, their behaviour is modelled mathematically, and the model parameters are adapted to experimental data structures.

For this purpose the required mathematical fundamentals are analysed and the required software are constantly developed at University of Applied Sciences Schmalkalden.

Research Areas

- Numerical Mathematics and Statistics, Software Development
- Data Pretreatment, Signal Analysis (MatLab)
- Mathematical Modelling with complex Markov Models
- Global fit routines for simultaneous adaptation of the models to several different data sets (C, MatLab)
- Studies on the accuracy of the fitted parameters

Contact

Faculty of Electrical Engineering
Mathematical Modelling
with Markov Models

Prof. Dr. Eckhard Schulz

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Profile

The laboratory for Microprocessor technology of the Faculty of Electrical Engineering is headed by Prof. Dr.-Ing. Andreas Wenzel. He is responsible for the teaching areas of technical computer science and embedded systems.

The laboratory supports the expansion of the learning content of the lectures: Microprocessor technology, microcontroller technology and embedded systems through appropriate tests and support of project work. The fundamental basis of the hardware and software design for embedded systems is communicated here in practice.

In projects and collaborations with companies and scientific institutions, the laboratory participates in research and development projects in the field of embedded diagnostic systems. So far a series of works in the field of medical technology have been implemented but also in technical applications.

Research Areas

- Design of Embedded Systems
- Design of Real-Time Software for microprocessor and microcontroller systems
- Signal Analysis Method
- Self-learning classification methods
- Design and implementation of diagnostic and test systems

Contact

Faculty of Electrical Engineering
Laboratory for Microprocessor Technology

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Profile

The development of mobile and distributed systems is one of the important challenges in current computer science. This becomes visible in trends like the "Internet of Things" or "Industrie 4.0." A considerable part of the foundations for these trends is the subject of the chair for "Software Development, Distributed and Mobile Systems" led by Prof. Dr.-Ing. Dr. phil. Michael Cebulla. In serveral courses the foundations of modern programming as well as theory and practice of mobile systems are taught to the students of computer science.

In the practical parts of their programs students have the opportunity to gather first experiences in real world development projects. For this sake the lab for mobile computing offers various working places for the development of distributed and mobile systems. Focus areas in this lab are:

- Conception and Development of mobile Applications. Students can develop their own ideas for mobile apps (with support of the teaching personal) and implement them on serveral platforms (e.g. Android (Google), iOS (Apple) and Windows Phone (Microsoft)). In addition to the development environment several mobile devices are available for testing and demonstration purposes.
- Architectural Integration of large IT-landscapes. A focus point in computer science is the architectural integration of large IT-infrastructures in enterprises. The chair offers competence and experience in this area and cooperates with local and non-local enterprises.
- Knowledge Processing in Distributed Systems. In several cooperations the technology of Complex Event Processing is applied in order to build up applications which are able to show adequate reactions to contextual changes quickly.

Our students are thus able to acquire knowledge and compentence in key areas of modern application development and to keep in touch with powerful trends like Internet of Things or Industrie 4.0. On the practical side they have the opportunity to develop their competencies and gain hands-on experience with multiple platforms and environments in the lab.

Research Areas

- Rapid Prototyping of mobile Applications
- Archtecture-driven Integration of large IT-landscapes
- Knowledge Processing in Distributed and Mobile Systems

Contact

Faculty of Computer Science
Software Development,
Distributed and Mobile Systems

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Profile

Prof. Dr. rer. nat. Klaus Chantelau represents the field of "Applied Digital Image Processing" at the Faculty of Computer Science with a focus on production of advertising media as well as industrial image processing. In addition to media production, this work area also includes the distribution of digital media over networks and associated issues in web development and mobile application development.

For the said working areas there is also a studio available for the advertising media production in the system for recording photo and video material, for post-production and for web development.

The studio for advertising media production is used in university teaching for projects and internships in the Bachelor degree program Multimedia Marketing and master's degree program in Applied Media Information Technology and thus makes a fundamental contribution to the understanding of media production and media transfer.

Projects in these areas are carried out in cooperation with companies and research institutes.

Research Areas

- Production of digital advertising media
- Multimedia and communications standards and development of multimedia network-based applications
- Software development for industrial image processing systems

Contact

Faculty of Computer Science
Production of digital advertising media

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intermediale
schmalkalden

Profile

The laboratory for Digital Audio Processing, led by Prof. Dr. Uwe Hettler, is used in the Faculty of Computer Science to introduce our students having a main focus on multimedia to the professional recording and editing of audio material, in particular music, spoken content and sounds. High quality audio is today provided in musical productions, promotional videos, radio spots, pod casts, and multimedia applications, but also in sound logos and ring tones.

A soundproof recording room, which is designed so that sound wave reflections are controlled, is available to us for sound recordings. Our studio is also suitable for the loud mixing of music. We can carry out processing of recordings by means of special hardware and software systems.

Our students use the existing equipment in the course of multimedia projects. We use the technology and the know-how for the creation of music productions, including our own compositions for contracting companies.

Research Areas

- Implementation of sound recordings
- Analysis of the effects of music for use in marketing
- Creating audio concepts, e.g. for the targeted integration into various advertising formats
- Composition (film music, music for websites, advertising jingles, sound logos)
- Music production incorporating computerized systems

Contact

Faculty of Computer Science
Digital Video Editing Laboratory

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WIM

Profile

Process and IT Management for companies and managing is the area of work of Prof. Dr. Regina Polster.

Based on organizational and process analysis, restructuring projects are conceived under consideration of IT technical possibilities and compliance requirements and supervised during the implementation.

Current key activities are in particular:

- Electronic Government and Public Controlling
- IT Service Management and IT Governance

Research Areas

- Introduction of document management and workflow management systems in companies and public administration, including acceptance Management
- Change Management for inter-agency and regional administrative reform projects
- Citizen participation through social media - Critical Success Factors and IT Safety basic requirements
- Scalability of IT Service Management based on IT Infrastructure Library (ITIL V3) / ISO / IEC 20000 for small and medium enterprises and development of a project process model
- Risk assessment of IT investments and monitoring of IT value contribution

Contact

Faculty of Computer Science
E-Government /
IT Service Management

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Profile

The research area of Multimedia Marketing is implemented through the interdisciplinary combination of several disciplines of economics and computer science.

A teaching and research area of the professorship deals with the media industry and the Net Economy. This concerns in particular the development of economically efficient, multi-media marketing strategies with the help of various information and communication systems.

The second teaching and research area of the professorship aims to develop user ergonometric presentations of multimedia information for PCs / laptops, notebooks / netbooks and mobile devices.

In the usability research area, laboratory investigations are carried out on human factors using electrophysiological and gaze tracking measurements (eye tracking). These findings from the communication and marketing research area are transmitted in order to investigate the effect of multimedia advertising campaigns.

Research Areas

- Analysis of market developments and trends for media markets
- Online, social community, neuro and mobile marketing
- Development of cross-media marketing strategies
- Monitoring economic key data for the cultural and creative industries
- Investigation of human factors, in particular emotional impact and influences

Contact

Faculty of Computer Science
Research Area of Multimedia
Marketing

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Profile

Laboratories for tribology & coating technology, lightweight structures & materials testing and the gravity field of biomaterials and biogenic materials belongs to the faculty of Mechanical Engineering and are led by Prof. Dr.-Ing. habil Annett Dorner-Reisel.

Professor Dorner-Reisel represents the Material Science, Technology and Selection for the study programs and further qualifications in general engineering, among others disciplines such as Industrial Engineering, Applied Plastics Technology or Engineering Renewable Resources.

Tribological tests and system improvements are among the traditional focus areas of teaching and research for tools and machine elements of all kinds at the University of Applied Sciences Schmalkalden. Within this tradition specialized knowledge is offered on the subject area as a lecture by Dr. Stefan Svoboda.

Close cooperation with regionally represented and globally operating industrial companies in the area of wear protection and development and for thermal spraying or cladding ensure practical training of students and skilled workforce retention in West Thuringia.

Thin and thick layers (for example, plasma enhanced CVD, PVD, sol-gel method, thermal spraying, hard facing) and their optimization are the subject of industry and public funded research projects.

In the laboratory for Lightweight Structures and Materials Testing the standardized testing of mechanical properties of structural materials is the basis for training as a mechanical engineer. The laboratory technology is essentially available for teaching in the Bachelor program by Dipl.-Ing. (FH) H. Albrecht and Dr. Stefan Svoboda.

Materials for Lightweight Structures are qualified in research and development projects. In addition to fine grain constructional steels and high-strength steel grades, particularly non-ferrous materials and the optimization of new manufacturing processes are the focus of research.

Plant and process technology for the production of large-scale aluminium and magnesium-based composite materials are optimized in cooperation with industrial enterprises. The reinforcement of light metals with high-strength fibres or wear resistant particles improve the elasticity module, high temperature strength and creep resistance. They are interesting for applications in the motor drive sector. Fibre-reinforced flat products (CFRP: carbon fibre-reinforced plastic; MMC: Metall-Matrix-Composites) can be used for the bodywork sector.

Load-bearing implants for hard tissue replacement are developed in the field of biomaterials. The mechanical properties of the ceramics are improved with fibres. Applications are particularly found in the field of weak load-bearing implants, which are to replace metallic biomaterials previously in use.

Another research focus is the tribology of the knee joint. After previous tribological model tests, layers of different thickness and nano structures are deposited on femur segments of the artificial knee joint. The knee joints are tested for up to 6 million cycles in the knee wear test according to ISO / FDIS 14243 (3 years). Interactions between biomaterials and cells are examined and excited in a targeted manner using actuatoric stimuli. Biogene materials are made from natural products, and partly use their naturally grown structures. For scarce resources, a successful recovery biogenic production can exploit considerable cost potentials.

Research Areas

- **Tribology & Coating Technology:**
- C-based thin-film systems (DLC: diamond-like carbon, Diamant) for the coating of forming and cutting tools
- Nano-structuring and doping of carbon layers and multi-layer coating systems (fuel cell electrode materials, actuators & sensors, biomaterials, automotive power train)
- Product development for thermally sprayed or refined surfaces through build-up welding
- (In cooperation with industrial partners)

- **Lightweight Structures and Materials Testing:**
- Casting technology manufacturing of metal-matrix composite materials (for example, squeeze casting, twin-roll casting)
- Optimization of load transfer from the matrix into the high-strength fibres
- Coating of carbon fibres with the goal of interface design
- Plant design and construction in laboratory scale and upscaling of technology

- **Biomaterials and biogenic materials:**
- Extraction and development of biogenic raw materials and template
- Development of load-bearing joint implants
- Interactions between biomaterials and living tissue: Signal and actuator functions
- (for example, piezoelectric stimuli, voltage generation in the supporting tissue, functional groups to surfaces)

Contact

Faculty of Mechanical Engineering
Laboratories for Tribology, Lightweight Structures, Focus on Biomaterials

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Profile

The Professorship for Thermodynamics and Fluid Dynamics provides an important contribution to engineering education in Mechanical Engineering. The curriculum includes classic technical thermodynamics, heat transfer, fluid mechanics, and intensive training in the subject of combustion engines and machines.

Within specific study programs, the application of numerical methods (FEM) in heat transfer and a course in refrigeration process technology is offered. For training there is a very well-equipped machinery lab with test benches for internal combustion engines. High quality numerical software for heat transfer and fluid dynamics round off the equipment with regard to modern technical engineering development methods.

Based on the aforementioned conditions there are very good prerequisites for scientific cooperation with interested parties from outside the university.

Research Areas

- Numerical simulation of heat transfer processes
- Simulation and calculation of pumps and compressors
- Refrigeration with natural refrigerants and refrigeration vacuum processes
- Heat exchanger - process engineering design
- Latent heat storage and PCM
- Thermomechanical calculations in hardening and shaping processes

Contact

Faculty of Mechanical
Engineering
Applied Thermodynamics and Fluid Dynamics

Prof. Dr.-Ing. Robert Pietzsch

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Profile

The laboratory of Applied Plastics Technology headed by Prof. Dr.-Ing. Thomas Seul belongs to the Faculty of Mechanical Engineering. He represents production technology and tool design in the faculty, particularly for the degree program in Applied Polymer Technology.

With the offered laboratory internships for students, the laboratory provides a supportive contribution to the expansion of knowledge gained in the lectures on Polymer Science and Polymer Testing and Plastics Processing with respect to the properties and application areas of polymers.

In addition, operation and procedural backgrounds of major plastics processing processes are illustrated.

Through collaborations and partnerships with regional companies there is a bidirectional exchange between science and industry. The focus is on the product development of plastic components and in mould design, especially for the medical device industry.

Research Areas

- Polymer Engineering of thermoplastics
- Die making of injection moulding dies (processes and technologies), in particular lubricant-free injection moulds
- Product and process development in medical technology in accordance with DIN EN 13485 and Design Control
- Guidance for Medical Device Manufacturers (FDA), surface technologies (e.g. metallic coating of plastics)
- Parameter determination of bio-based and medical polymers

Contact

Faculty of Mechanical
Engineering
Laboratory for Applied
Plastics Technology

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Profile

The Laboratory for Machine Dynamics of Mechanical Engineering is involved in the teaching field of "Kinematic and Dynamic Simulation" (Masters Course in Mechanical Engineering).

The dynamic behaviour of machines and vehicles or their components is simulated on the computer using multi-body systems. The results of these calculations are compared with measurements on real objects. In this manner parameters can be compared and the calculation model is confirmed.

Research Areas

- Calculation / simulation of dynamic systems
- Measurement of dynamic quantities of mechanical and mechatronic systems

Contact

Faculty of Mechanical
Engineering
Laboratory for Machine
Dynamics

Prof. Dr.-Ing. Georg Weidner

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Profile

The interdisciplinary focus on Information Law at the Faculty of Business Law is headed by Prof. Dr. Ulf Müller and Dipl.-Ing. (TU) Matthias Dick.

It is particularly concerned with intellectual property rights, competition and copyright, data protection, data security and mail management in enterprises and administrations.

There are opportunities for cooperation:

- Through the supervision of business-related theses at bachelor and masters level
- On site consultations incl. vulnerability analysis
- Through lecturing activities

Research Areas

- Copyright in the Information Society
- Trademark Law in the internet
- Data protection and data security
- Digital business and administration processes
- Mail management

Contact

Faculty of Business Law
Focus on Information Law

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Profile

Prof. Dr. Ulf Müller is Professor of Business Law at the Faculty of Business Law.

After his legal training he worked as a lawyer in international law firms in Dusseldorf and in his own office from 1998 to 2009.

From 2002 to 2008 he was also a researcher at the Institute / State Competence Centre for Information, Telecommunications and Media Law (ITM) at the University of Münster. In 2004 he was a Visiting Fellow at Georgetown University in Washington D.C. (USA). In addition to his legal practice, he spent several years managing a publishing company.

He is a member of the Advisory Board of the Consumer Centre in Thuringia e. V.

The focus of the scientific work of Prof. Müller is in national and international information, copyright, licensing and antitrust law.

Research Areas

- Copyright in the Information Society
- Hybridity and Internet economics - Antitrust issues
- Trademark Law in the internet
- Right and space
- Homeland and Law
- Consumer Protection Law

Contact

Faculty of Business Law
Private Commercial Law

Prof. Dr. Ulf Müller

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Profile

Professor Dr. Sven Müller-Grune is Professor of Public Business Law at the Faculty of Business Law.

After studying law at Jena and Granada (Spain) he was a researcher at the University of Erlangen-Nuremberg. He completed his doctoral work on an administration topic at Bonn University. Since 2001, Professor Dr. Sven Müller-Grune has practised as a lawyer in the field of public law. He is a specialist of administrative law since 2003.

In the field of public commercial law, the activities of Prof. Dr. Müller-Grune are focused on the processing of product law, construction law and corporate law issues. Both in his legal practice as well as data protection officer at the University of Applied Sciences Schmalkalden he has worked intensively on data protection issues.

Research Areas

- Law on product safety
- Administrative Procedures and Administrative Procedural Law (including Comparative Law in Latin America)
- Cooperations governed by Public Law
- Law of employment promotion (especially short-time compensation)
- Law of urban land-use planning

Contact

Faculty of Business Law
Public Business Law

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Profile

The Chair of Economic Law of Prof. Dr. Schackmar has worked in international business law and in national and international insolvency law.

Prof. Dr. Schackmar studied business administration at the VWA Münster and law at the University of Münster. After the 2nd bar exam, he practised as a lawyer in a non-local, commercial law firm focuses on international law. In this case, acted for and advised mainly enterprises in international litigation and arbitration, and in shaping international law contracts. From 2001 to 2003 he was Professor of international law at the University of Pforzheim. In 2003 he accepted the appointment of a professor of international economic law at the University of Schmalkalden in South Thuringia. There, Prof. Schackmar teaches in particular international law in English for aspiring corporate lawyers and for masters degree students of business law. In addition, he has held visiting professorships at an English, French and Romanian University.

Research Areas

- International unified commercial law, particularly UN Sales Law (CISG)
- International Private Law (IPR),
- International Civil Procedure (e.g. EuGVVO)
- International commercial terms, especially INCOTERMS®.

Contact

Faculty of Business Law
Business Law

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Profile

The professorship for Business Law of Prof. Dr. Schneider works in the core area of the Faculty of Private Commerce Law and in the field of quality management.

This includes the mapping of basic subjects in civil law. In addition, the neighbouring right is a scientific area of interest. Here, Prof. Dr. Schneider touches on the border between public and private law, e.g. by examining neighbour related legal consequences within the framework of the energy transition.

The interest in quality management is reflected in various projects for applied research, consulting and teaching. Focus is on ISO 9001 and its implementation in medium-sized companies and organizations. It covers both manufacturing companies and service providers.

Process and process optimization strategies and resulting approaches for a CIP process are developed, in addition to analysis of the implementation. The activity portfolio extends beyond the creation of a quality documentation on the use of standard tools of quality management to the construction of an audit system in promoting quality improvement.

There are opportunities for cooperation through scientific monitoring of implementation processes and CIP projects, including in the scope of lectures and consultancy work.

After his time as a research assistant at the University of Würzburg in 2005, Prof. Dr. Schneider worked as an attorney in the international law firm of Freshfields Bruckhaus Deringer. From 2005 until his move to the HSM, he was legal director of a major district town. As a subsidiary office, Prof. Dr. Schneider acted as the commercial director of a charitable housing association, member of the management of a Business and Innovation Centre and Associate Judge at the Administrative Court.

Research Interests in Private Business Law

- Public and private neighbouring law
- Real estate law, especially planning law
- Law relating to neighbouring and renewable energy
- Business start-ups and European Law
- General (public and private) contract law

Research Interests in Quality Management

- Quality Management, in particular the implementation of ISO 9001
- Process optimization
- Continuous improvement processes incl. tools of quality improvement
- Establishing and maintaining an audit system

Contact

Faculty of Business Law
Professor of Business Law / interest focus on Quality Management

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Profile

The focus on Human Resources, Labour and Social Law at the Faculty of Business Law is led by Professor Dr. Mathias Ulbrich, LL.M.

It continually examines current issues of corporate practice and legal and business innovations with impact on the economy, which are especially treated in a public practice seminar.

There are opportunities for cooperation through:

- the supervision of business-related theses at bachelor and masters level,
- professional lectures,
- the posting of internships,
- Preparation of expert opinions,
- Establishing an institute for Company Pension Plan ("bAV") with external partners (e.g. consultancies, law firms, insurance companies).

Research Areas

- Human Resources management
- Corporate and personnel management
- Labour law
- Company pension plans (bAV)

Contact

Faculty of Business Law
Focus on Human Resources,
Labour and Social Law

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QuR
Qualität und Recht

Profile

Dr. Hildegard Breig joined the faculty in 2001 and has been full-time professor of business and economics since 2002. Her teaching covers a broad range of subjects including bank behaviour, regulation, portfolio theory and business cycle analysis. She graduated at the University of Freiburg i.Br. (Diploma in Economics, 1980) and at the University of St. Gallen (Dr. oec., 1986). After that she gained professional experience as a bank economist.

Research Areas

- Trade credit
- Payment behaviour
- Exchange rate volatility

Contact

Faculty of Business and Economics
Focus on International Finance

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Profile

The research group Flexible Manufacturing Technologies is made up of a team of researchers from Ernst Abbe University of Applied Sciences Jena (EAH), SciTec and the University of Applied Sciences Schmalkalden (HSM), Electrical and Mechanical Engineering faculties. Thanks to this national and cross-university cooperation, this combines available research expertise for clarifying issues related to flexible manufacturing technologies. The research group is part of the activities that are related to the Thuringian Centre of Mechanical Engineering.

- Cooperating Professors: Prof. Thomas Seul, responsible for the overall project (HSM), Prof. Jens Bliedtner (EAH), Prof. Andreas Wenzel (HSM)

Today, attention is being increasingly focused on innovative ways to manufacture new products. It makes no difference here, that investigations are in the direction of the additive processes for small series and in the tool and forming technology. The common goal of all these methods is the most cost efficient and faster production of components for various areas of daily life.

What all methods have in common is that they produce different products, whether it is the end product of metal or plastic or semi-finished products made of metal and composite materials, which are processed in further steps into the final product.

For this reason, the research group Flexible Manufacturing Technologies, consisting of the professorships for Product Development / Design, Embedded Systems / Technical Computer Science and Production Engineering / Tool Design, aims to improve existing manufacturing processes and to establish new ones.

Research Areas

- High performance machining processes
- Power Moulds
- Additive production
- Innovative abrasive manufacturing processes for 3D machining processes

Staff and facilities

Five scientific employees from three disciplines work together in various disciplines in the research group. The research group has full access to the measuring devices in the various disciplines. In addition, the following instruments and tools were purchased as part of the research group:

- Keyence measuring microscope
- Ultrasonic testing apparatus: Phased array test device Phasor XS
- 2-K sample body tool for the production of tensile test bars made of two different components with different overlapping structures

Contact

Overall Project Coordination /
Flexible Manufacturing
Technologies

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ESF
EUROPA FÜR THÜRINGEN
EUROPÄISCHER SOZIALFONDS

Profile

In the field of work processes, efficient strategies for machining of lightweight structures were explored. Little is known about how the dynamic loads of cutting production affect the composite material of sandwich or composite material structures. The working area of the University of Applied Sciences Schmalkalden focuses on the non-destructive inspection of cutting and clamping surfaces on machined components.

The objective is the production of machine elements by cutting and abrasive machining of lightweight structures for continuous use at high temperatures with the requirement for a long service life.

For this, the components after machining (drilling, turning, milling) or ablation (laser) are examined by ultrasound and evaluated for delamination effects and microcracks, so as to characterize the component properties after the machining process.

For industrial use, the method of analysis will be further developed during the project and a corresponding guide for practical use will be prepared. In the further course of the project the long-term behaviour of the machined structures will be characterized and correlated with the findings of the non-destructive testing through creep tests. For this purpose, an endurance test stand will be developed and implemented with which the investigation of parts processed under temperature conditions and chemical influence is possible. The aim is to evaluate long-term effects through cutting operations processes of lightweight structures.

Research Areas

- Production of demonstrators from composite materials
- Investigation of microcracks and delamination effects using ultrasonic equipment
- Investigation of the long-term behaviour of composite structures under continuous load and chemical influence

Staff and facilities

The objective is the production of machine elements by cutting and abrasive machining of lightweight structures for continuous use at high temperatures with the requirement for a long service life.

For this purpose the components after machining (drilling, turning, milling) or ablation (laser) will be screened by ultrasound and examined for delamination effects and microcracks and the component properties characterized. For industrial use, the method of analysis will be further developed during the project and a corresponding guide for practical use will be prepared.

In the further course of the project the long-term behaviour of the machined structures will be characterized and correlated with the findings of the non-destructive testing through creep tests. For this purpose, an endurance test stand will be developed with which the investigation of parts processed under temperature conditions and chemical influence is possible.

Contact

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Profile

The subject of sensor-based tools is becoming increasingly important for the manufacturing industry, since several parameters can be better monitored with the appropriate tools. In the field of injection moulds, sensor-based tools have already been known for some time and are used in various processes. Currently, the sensors usually play passive roles in production, which means that the information from the sensors values can be displayed and the machine operator can intervene the existing production process based on this intervention. This requires some understanding of the injection moulding process and the role of the variable parameters in advance, e.g. injection flow rate, holding pressure profile and cooling time, in order to achieve a higher quality of the parts to be produced through specific changes in the parameters.

At present, various sensors are used to define the injection moulding process. Thus an in-line viscosity measurement is possible, the switch point using pressure sensors or temperature sensors. The die deformation can also be used as a measurement variable. Acoustic emission sensors may also be used in addition to the usual piezo elements. In line with these possibilities, injection moulding dies are equipped with pressure and temperature sensors, among other things, and the signals are evaluated during the injection cycle.

There are plans for the system injection moulding machine- injection mould to regulate itself and thereby direct intervention of the operator during production is only conditionally necessary. However, the machine operator is able at any time to read the data of EDS (EDS = Embedded Diagnostic System) and actively intervene in the process.

Recording of data is necessary for the purposes of CE marking of an injection moulding die, if the injection mould is not being used for the production of components. Thus, it is possible to document the ambient air in which the injection mould is stored by means of temperature and humidity measurement sensors in order to better assign damages to the dies (e.g. corrosion or the dulling of glossy surfaces).

Research Areas

- Reducing set-up times through intelligent tools and forms
- Ensuring constant quality of the manufactured products
- Determination of die wear during the production processes
- Monitoring and documentation of storage conditions of tools and moulds

Staff and facilities

At present, various sensors are used to define the injection moulding process. Thus an in-line viscosity measurement is possible, the switch point using pressure sensors or temperature sensors. The die deformation can also be used as a measurement variable. Acoustic emission sensors may also be used in addition to the usual piezo elements. In line with these possibilities, injection moulding dies are equipped with pressure and temperature sensors, among other things, and the signals are evaluated during the injection cycle.

It is envisaged that the system for injection moulding machine-injection mould will regulate itself and thereby direct intervention of the operator during the production is no longer necessary. However, the machine operator is able at any time to read the data of EDS (EDS = Embedded Diagnostic System) and actively intervene in the process.

Recording of data is necessary for the purposes of CE marking of an injection moulding die, if the injection mould is not being used for the production of components. Thus, it is possible to document the ambient air in which the injection mould is stored by means of temperature and humidity measurement sensors in order to better assign damages to the dies (e.g. corrosion or the dulling of glossy surfaces).

Contact

Sub-project management Powermoulds

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Profile

The cutting and crushing of goods is one of the most important procedural processes and plays a significant role in virtually all areas of the manufacturing economy and industry. Almost 4% of total electricity consumption in the world every year is spent on it, whereby cutting has become a part of the basic crushing processes. Especially crushing, but also drying and separation processes, form a significant share of the primary energy supply, especially in countries producing raw materials. With increasing world production and the trend of having to handle finer particle systems, there is a continually increasing demand for energy, which is reflected in the costs and in the CO2 emissions of the respective processes. This must be countered by the development and introduction of energy efficient processes.

Wear in cutting processes has long been an important issue in many areas of industry, ranging from metal processing to the processing of agricultural crops.

In the terms of mechanical properties, the layered structure of the components is an undeniable disadvantage of additive production processes. This disadvantage could be used for regenerating wear protection layers using a deliberate, targeted detachment of a layer of material. For this purpose, in comparison, functional components are produced and tested based on the LOM method and the SLS method with different materials. The composite layer should be selectively adjusted so that detachment can occur under a defined load or a low residual layer thickness, even if through selectively set priorities during SLS due to a revised process management. A self-sharpening effect can be achieved through layer structure arrangement (alignment) and thickness. In comparison the metallic materials are considered as a reference of the mechanical properties.

In combination with polymers, a possible environmental impact can be reduced because the detaching particles break down in the environment.

Biobased materials are to be tested in order to expand the currently available materials. As a reference, starch-based components are tested and compared with an extruder. To increase the strength of the component a fibre addition is tested in the powder bed (improvement in properties perpendicular to the layer). Preferably, natural fibres are to be used here. Using the example of lignin-based material, the question of a recyclability is also to be considered for the material selection.

Research Areas

- Wear-resistant coatings
- Expanding the available materials

Staff and facilities

In the terms of mechanical properties, the layered structure of the components is an undeniable disadvantage of additive production processes. This disadvantage could be used for regenerating wear protection layers using a deliberate, targeted detachment of a layer of material. For this purpose, in comparison, functional components are produced and tested based on the LOM method and the SLS method with different materials. The composite layer should be selectively adjusted so that detachment can occur under a defined load or a low residual layer thickness, even if through selectively set priorities during SLS due to a revised process management. A self-sharpening effect can be achieved through layer structure arrangement (alignment) and thickness. In comparison the metallic materials are considered as a reference of the mechanical properties.

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Biobased materials are to be tested in order to expand the currently available materials. As a reference, starch-based components are tested and compared with an extruder. To increase the strength of the component a fibre addition is tested in the powder bed (improvement in properties perpendicular to the layer). Preferably, natural fibres are to be used here.

Using the example of lignin-based material, the question of a recyclability is also to be considered for the material selection.

Contact

Sub-project management
Additive Production –
HSM work packages

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Profile

As part of the research group, the ultra precise and highly dynamic athermal laser machining, and the ultrasound-assisted shape and profile grinding are to be explored in this focus field.

In each case, the observation of the entire process chain has priority. The objective is to scientifically investigate ablation processes and, based on the findings and new knowledge, to deduce the approaches for improving processes on the one hand, and to open up new fields of application for the procedures on the other hand.

The state of technology in the field of ultra short pulse processing (UKP) is dominated by German and American publications. This shows that the use of laser radiation extension of work permits accuracy in the precision and ultra-precision range. A very large market potential is forecast worldwide for applications in this area.

Research Areas

- Ultra-precise and highly dynamic athermal laser machining
- Technology of ultrasonic-assisted moulding and profile grinding

Contact

Additive Production –
EAH work packages and
innovative abrasive manufacturing processes for 3D machining processes

Prof. Dr.-Ing. Jens Bliedtner

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Profile

"Mechanical engineering is a key industry of the Thuringian economy whose potential must continue to be used and expanded." The potential must be used consistently. The prerequisite is that the Thuringian mechanical engineering aligns the global economic trends in plant engineering, mainly due to the demand in the emerging markets. Therefore Thuringian mechanical engineering experts have to align themselves in business and science in the same direction, because only then the necessary offers can be created and innovations triggered.

The "Thuringian Center of Mechanical Engineering" (ThZM) is exactly the right instrument for this purpose. It brings together scientific and entrepreneurial skills in projects and helps the Thuringian mechanical engineering to be even more flexible, more precise and more resource-efficient. This gives it a forward-looking orientation.

In mutual exchange, the partners will gain new insights:

"Companies benefit from a research and development infrastructure tailored to their needs and universities will be able to gain important experience for their further research."[1])

For this purpose, five Thuringian research institutions have come together in a joint initiative to address the challenges in the form of ThZM:

- Technical University of Ilmenau
- Günter-Köhler-Institute for Bonding Technology and Material testing GmbH Jena
- Ernst-Abbe-University of Applied Sciences Jena
- GFE Schmalkalden
- University of Applied Sciences Schmalkalden

Currently, the following research groups and collaborative projects have been evolved based on the activities of ThZM:

- Flexible Manufacturing Technologies
- In-process quality assurance
- Scanner based dynamic precision machining with highly brilliant beam sources
- In-process quality assurance - contactless sensor system
- Laser material processing high-performance plastics in mechanical engineering - cutting and joining

The ThZM acts as a multiplier for knowledge transfer and research and development projects and is therefore open to Thuringian companies in the industry who want to get involved in the work of ThZM. This is the prerequisite for unbeatable, new national and international research and development networks.

[1]) from the preamble of the ThZM website

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