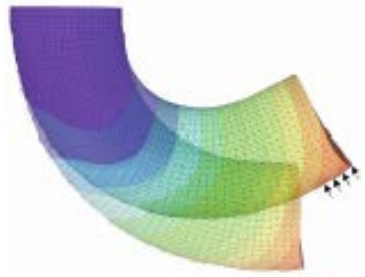
Institute of Dynamics and Vibration Research (IDS)

https://www.ids.uni-hannover.de/en/

Performance optimization of a soft robotic actuator

The research group Contact Mechanics of Elastomers deals with the contact description and modelling of different elastomer components and their counterparts. One of the projects within the research group deals with modelling and the contact behaviour of soft robotic systems. Within the project the modelling and behaviour of a soft pneumatic actuator is investigated. The actuator is made of two different silicones and has three pneumatic chambers radial along its longitudinal axis. Pressurization of one or multiple chambers leads to deformation of the actuator.

As part of the Science and Engineering Research Program, we aim to evaluate and enhance existing ideas to optimize the soft actuator's performance in order to realize larger deformation for low input pressures. In a first step, different approaches will be evaluated and enhanced. Afterwards, the optimization approaches will be implement in a finite element model of the current actuator. Based on the simulation results the approaches will be evaluated to optimize the performance with regards to large deformation. Additional approaches based on previous results may be developed and the best approach can be manufactured for further testing.



Requirements:

- Interest in simulation
- self-motivated and independent work

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Institute for Continuum Mechanics (IKM)	https://www.ikm.uni-hannover.de/en/

PINNs for shape function computation

Simulation-driven product development is nowadays an essential part in the industrial development process and the interest in realistic high-fidelity simulations is significant. As a versatile tool, meshfree methods have gained attention in the last decades. However, along with their flexibility in discretization, meshfree Galerkin methods often endure a decrease in accuracy, efficiency and stability compared to meshbased methods. While satisfying certain shape function requirements, the Peridynamic Galerkin methods provide a sound approach for the modeling of highest deformations on arbitrarily distributed point clouds. For this purpose, special shape functions have to be constructed in a cumbersome procedure. To improve the applicability of the method, the construction of shape functions using physics informed neural networks (PINNs) shall be investigated in the current project.

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Institute for Assembly Technology (match)

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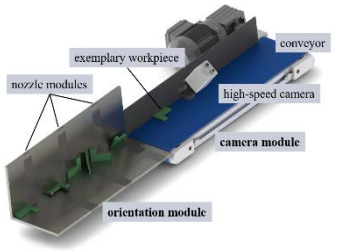
A crucial component of automated assembly is the feeding device, which provides the handling device (e.g. industrial robot) with the components to be assembled in a defined position and orientation (pose). At match, methods for active image-based feeding of components using aerodynamic orientation modules are being researched. The active method allows high feeding rates to be achieved, while the use of image processing and aerodynamic actuators provides a high degree of flexibility with regard to the component shape.



Possible fields of research within the current project are:

- **High-speed image processing: Classification of arbitrary component's orientations using synthetic (rendered) training data.**
- **Physics simulation: Determination of component behavior in the feeding system dependent on aerodynamic impulses**
- **Demonstrator: Development of an experimental Demonstrator of a new aerodynamic feeding system. Gathering of empirical data and knowledge about the feeding process.**

Introduction to aerodynamic part feeding:
https://www.youtube.com/watch?v=hjeN-JBfJ0g

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Design of a non-destructive testing method integrated into a handling system

At the Institute of Assembly Technology (match), we want to utilize the time during handling processes to carry out quality control tasks. The parallel execution of handling and testing increases the efficiency of the manufacturing process. For this purpose, gripping systems are required that have integrated measuring technology to non-destructively examine the objects during handling operations. Therefore, research work must be carried out to investigate the feasibility of said technologies. Based on this research, a gripper must be designed.

Required skills:
Basic knowledge in construction (solid Works or similar CAD programs), Commitment and an analytical, structured and independent approach to work.

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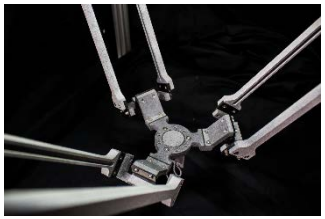
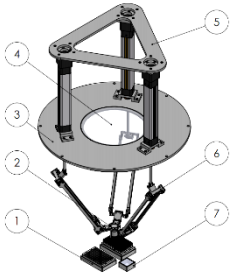
Institute for Assembly Technology (match)

Methods for automation of handling processes in a cryogenic working environment



Within the framework of the DFG-funded project "Methods for the automation of handling processes under cryogenic environmental conditions", we research approaches for the automation of handling processes in biobanks for cryopreservation in the temperature range below -209°F. The automation system is based on a parallel robot, as its structure allows the placement of the actuators outside the cooled workspace. The robot's joints and actuators are located in the interior of the biobank cooled with liquid nitrogen. The challenge is to ensure the functionality of the machine components of the robotic system (joints, sensor network, drives and power supply) in the temperature range -209°F to -320°F to be able to operate the biobank permanently at this low-temperature level. This is the only way to protect the stored samples from damage due to temperature fluctuations and, at the same time, to ensure the efficiency and freedom from errors of the handling processes. Vertically arranged electro spindles drive the robot, and the control of these drives is implemented with the aid of a PLC. In the first approach, the basis for the control is the analytically determined IKP of the parallel robot structure. In a subsequent step, the possibility of incorporating position and sensor data into the control of the robot is to be created. Finally, a motion sequence with the real parallel robot is to be implemented for demonstration purposes, mapping the subsequent storage, retrieval and relocation process.



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Institute of Materials Science (IW)

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A study of the magnetic properties of different alloys by measuring susceptibilities on a Lock in Amplifier device

In this research, the magnetic properties of magnesium alloys and CoNiAlFe alloys will be investigated to determine how the magnetic characteristics change depending on the alloy composition and the macro structure of the casting.
The investigations are carried out within the ongoing research projects "Development of multicrystalline two-phase CoNiAl shape memory alloys with high functional stability" and "Electro-pulse treatments of magnesium wires":
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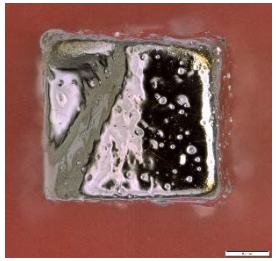

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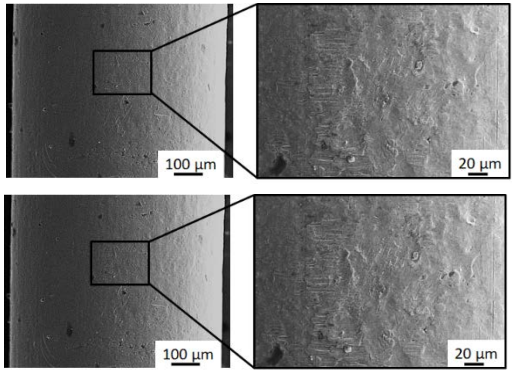
Pressurized thermal sintering of billets for melting NbSi-alloys containing nano powders

This study aims to identify the decisive technological steps that will allow the successful mixing of very fine powder additives of different fractional composition into the matrix of the alloy NbTiHfCrAlSi and silicide composites (MASC).
The investigations are carried out within the ongoing research project " Particle modification of niobium MASC alloys by processing under semi-levitation in a cold wall induction crucible":



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Institute of Materials Science (IW)

Investigations of diffusible hydrogen in underwater wet welding

Underwater wet welding is an important technique for repairing and construction underwater. Research and development in this area are performed at the Institut für Werkstoffkunde/UWTH (Institute of material science). The direct contact between the arc and the water promotes diffusible hydrogen in welds, which turns in considerable cause of hydrogen-induced cracks. This project has the focus on correlating the electric parameters of the welding process and the diffusible hydrogen values in the weld beads through Data Analysis methods. Welding tests and diffusible hydrogen have to be carried out with experimental equipment at the institute.

Required qualifications:

- Basic knowledge in Data science and Welding technology

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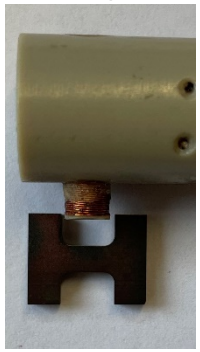
Development of an eddy current sensor system to monitor in-situ SEM tensile tests

The focus of our research group is the development and adaption of non-destructive testing methods to monitor material behavior. In this project the aim is to develop and built an eddy current sensor system to detect microstructural changes in in-situ Scanning Electron Micrsocope (SEM) tensile tests. Eddy current testing signals can be correlated to microstructural changes when the phase undergoes a transformation from ferromagnetic to paramagnetic. Eddy current sensor systems to monitor tensile tests already exists in our research group. However, it is a great challenge to miniaturize an eddy current sensor so that it is able to be inserted into a SEM. This project will work together with another German project thesis, which focuses on the tensile tests and sample preparation.



Required skills: Interest in practical work, good team work skills

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Institute for Thermodynamics (IfT)

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Experimental and Theoretical Characterization of Compact Heat Exchanger with a background in Additive Manufacturing

Additive Manufacturing is a powerful emerging technology, which will enable new designs for compact heat exchanger. The geometrical structures within the fluid flow channels can be optimized on behalf of heat transfer performance and low pressure drop. At the Institute, design procedures are developed to find the optimal structure for a given fluid application, using CFD calculations and CAD programs. These structures have to be validated experimentally. The research project could be either focused on numerical calculations and/or experimental validation on existing experimental set ups.

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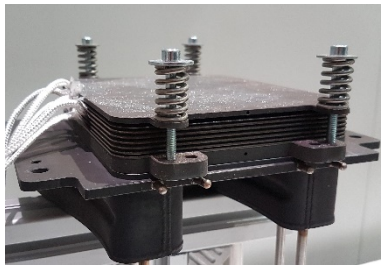
Experimental characterization of a Fuel Cell

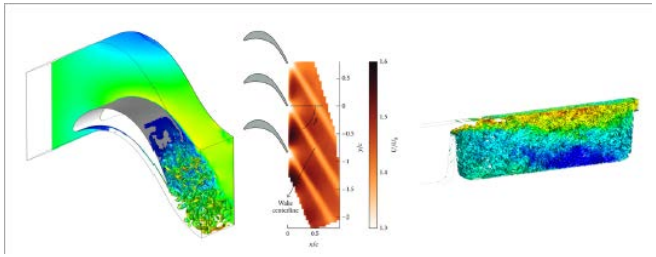
Fuel cell systems are an important energy conversion device to deliver "green" electric energy on demand from a hydrogen storage tank. At the Institute, polymer electrolyte membrane (PEM-FC) fuel cells as well as solid oxide electrolyte fuel cells (SO-FC) are characterized in experimental setups. The research project will aim at a specific parameter to be evaluated upon its impact on fuel cell performance, for example the moisture on the performance of a PEM-fuel cell.



Institute of Turbomachinery and Fluid Dynamics (TFD)

https://www.tfd.uni-hannover.de/de/

Postprocessing Tools for Scale Resolving Simulations



Scale resolving simulations (SRS) of turbulent flows in engineering applications can provide deep in-sight into the physics of the flow. So, they and can help to improve the aerodynamic, aeroacoustic and aeroelastic design of turbomachinery. They can also be used to develop or improve RANS turbulence and transition models for industrial ap-plication. High quality and reliable SRS require careful evaluation of convergence and consistency of the solution process and the time averaged results. Therefore, a python tool was developed by the German Aerospace Center (DLR) that enables the user to evaluate the initial transient of a time resolved simulation and to estimate the statistical sampling error of time averaged variables.

In this project the DLR-tool shall be implemented into the post processing routine of the TFD. Its performance, functionality and potential shall be analysed based on its application to available SRS-Results at the institute.

Your Profile:

- Experiences with Linux and Python or data processing recommended
- Independent and focussed work

Your Tasks:

- Study of scientific data analysis with python
- Use of a Python tool to analyse time resolved data with Python
- Documentation and presentation of the results

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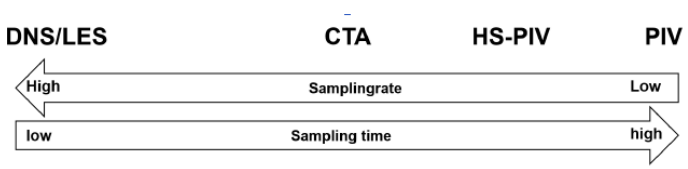
Institute of Turbomachinery and Fluid Dynamics (TFD)

Implicit Filtering of Time Resolved Measurements

Future development of turbomachinery is driven by high fidelity computational fluid dynamic simulations (CFD) and high fidelity experimental measurements. Every of these methods has its own limitations and requirements regarding the sampling period and sampling rate. As an example, Direct Numerical Simulation requires sampling rates of a few MHz, while the costs for computational resources does not allow sampling periods of more than a few milliseconds. The spatial re-solution of DNS is as high as the dissipative, so called Kolmogorov scales of the flow. In contrast to this, Particle Image Velocimetry (PIV) has a spatial resolution of a few pixel only, a sampling rate of few Hz, but a sampling time of some minutes. These contrary characteristics have an influence on the applicability of the methods to certain flows in turbomachinery.



The sampling rate of the CFD or experimental method can be interpreted as a temporal filter. Within this project, the influence of different temporal filters applied to time resolved measurements and SRS-Simulations of turbulent flows in turbomachinery shall be analysed. Therefore, generic but physically meaningful signals will generated and process using python.

Your Profile:

- Experiences with Linux and Python or data processing recommended
- Independent and focussed work

Your Tasks:

- Study of scientific data analysis with python
- Evaluation of different temporal filters applied to time resolved measurements of turbulent flows in turbomachinery
- Documentation and presentation of the results

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Institute of Turbomachinery and Fluid Dynamics (TFD)

Experimental Investigations of Water Separation Concepts for Fuel Cell Systems

Exhaust air from PEM fuel cells contains water, which can damage downstream components in the flow path, e.g. a turbine used for energy recovery. The aim of this project is to test several water separation concepts for fuel cell systems using specially developed small-scale experiments.

Required Skills:

- Experience and interest in experimental research

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Institute for Multiphase Processes (IMP)	https://www.imp.uni-hannover.de/

Analysis of the preservation of cell seeded tissue engineered constructs

Tissue Engineering is a promising approach to replace or regenerate damaged tissue in patients. In this regard, electrospun scaffolds can be seeded with specific cell types and function as a tissue substitute. A drawback is the limited shelf-life of biological materials, such as cells. Therefore, we aim to enhance the shelf-life of cells seeded on the tissue engineered constructs by cryo- and hypothermic preservation. In this proposed student work, the preservation of cells, seeded onto electrospun scaffolds, will be analysed as well as the properties of the utilized polymers (for electrospinning) and applied cryoprotective/hypothermic agents.

Required skills: General knowledge in natural sciences (biology, physics and chemistry) and biomedical/mechanical engineering/life science, laboratory work, statistical analysis, independent working.

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Prof. Prof. h.c. Dr.-Ing. Birgit Glasmacher, M.Sc.

Cryopreservation of stem cells by electroporation-assisted loading with sucrose

Dimethyl sulfoxide (DMSO)- and serum-free cryopreservation of cells and tissues is a promising method to protect the cells during freezing and thawing, avoiding possible toxicity of DMSO and the xenogeneic serum. Electroporation of the cells allows to load the cells with different alternative cryo-protective agents such as sucrose to be able to ensure cell protection during cryopreservation.
Within the scope of this project, a method for the cryopreservation of cells by cell loading with sucrose by electroporation will be established at the institute using the BTX™ Gemini X2 electroporation device. In addition, the behavior of the cells during the freezing and thawing processes will be analyzed using cryomicroscopy.

Required skills: The student should be familiar with the Safety rules and Rules for sterile work in cell culture laboratory and Electroporation Hardware Safety. The basic knowledge of handling with cells is as well required.

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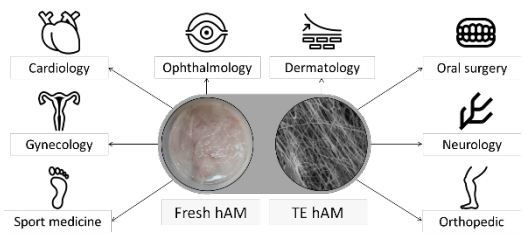
Prof. Prof. h.c. Dr.-Ing. Birgit Glasmacher, M.Sc.

Institute for Multiphase Processes (IMP)

Biocompatibility and degradation of tissue-engineered constructs

Tissue engineering (TE) is the most promising approach to develop tissue-engineered constructs comprising cells and scaffolds to replace or regenerate damaged tissue in patients. The human amniotic membrane (hAM) has been employed as a scaffolding material in TE for different applications in corneal treatment, wound dressing, urology, and other areas.



However, the good results of hAM for its biological properties (such as antibacterial, angiogenetic, antifibrotic, and anti-inflammatory properties). The mechanical properties and the biological properties of hAM vary between donors, the placenta's zone, and the delivery method. To face those challenges, we aimed to include hAM in polymeric scaffolds obtained by the electrospinning process, and the biological, mechanical, and chemical properties should be characterized. The student will be involved in fabricating the membranes and further characterization.

Required skills: laboratory work, statistical analysis.

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Prof. Prof. h.c. Dr.-Ing. Birgit Glasmacher, M.Sc.

Institute for Factory Systems and Logistics (IFA)

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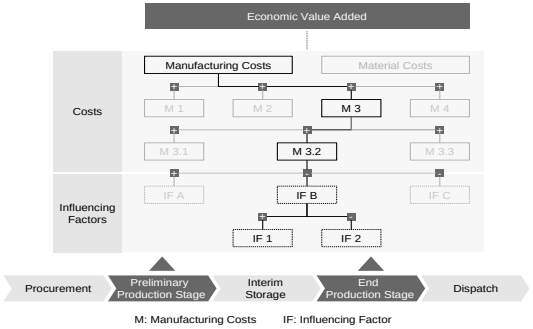
Development of a Cost Framework on Manufacturing and Material Costs Based on a Systematic Literature Review

Processual and organizational innovations have the potential to provide competitive advantages for companies. However, an evaluation of the impact of innovations on monetary and logistic targets prior to implementation is difficult due to non-transparent correlations. Following the overall approach of a framework for the evaluation of innovations in terms of their impact on monetary and logistical objectives, the aim of this student research project is to develop a framework that initially supports a monetary evaluation of innovations. For this purpose, manufacturing and material costs have to be systematized based on the Economic Value Added by means of a systematic literature review.



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Integration of Planning and Operation of Complex Production Systems with Model-Based Systems Engineering (MBSE): A Potential Analysis

Shorter product life cycles combined with increasing product/variant diversity pose significant challenges to production systems in aircraft manufacturing. At the same time, there is a growing need to further automate individual process steps in the assembly of large components. In this context, linking the planning and operating phases of such complex production systems is becoming increasingly important.

To overcome this barrier, migration strategies and decision-making approaches are required to help the industry in the gradual introduction of the next generation of intelligent production systems step-by-step. However, it is particularly important to consider not only the technical aspects but also organizational and production logistics issues (e.g., minimizing lead time,...). A key component of these approaches is the comparative evaluation of migration scenarios in the early planning phase.

Model-Based Systems Engineering (MBSE) is based on a model-based approach to integrate all technical and logistical disciplines and therefore offers a quite promising approach to address the challenges described in the previous sections. Within the scope of this project, there is the possibility to support an industry-related research project in the form of a

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potential analysis. Thereby it would be your task to identify options and limitations of the MBSE approach in the context of logistical-oriented production system design.	