



Technische  
Universität  
Braunschweig

INSTITUT FÜR  
mobile Maschinen  
und Nutzfahrzeuge



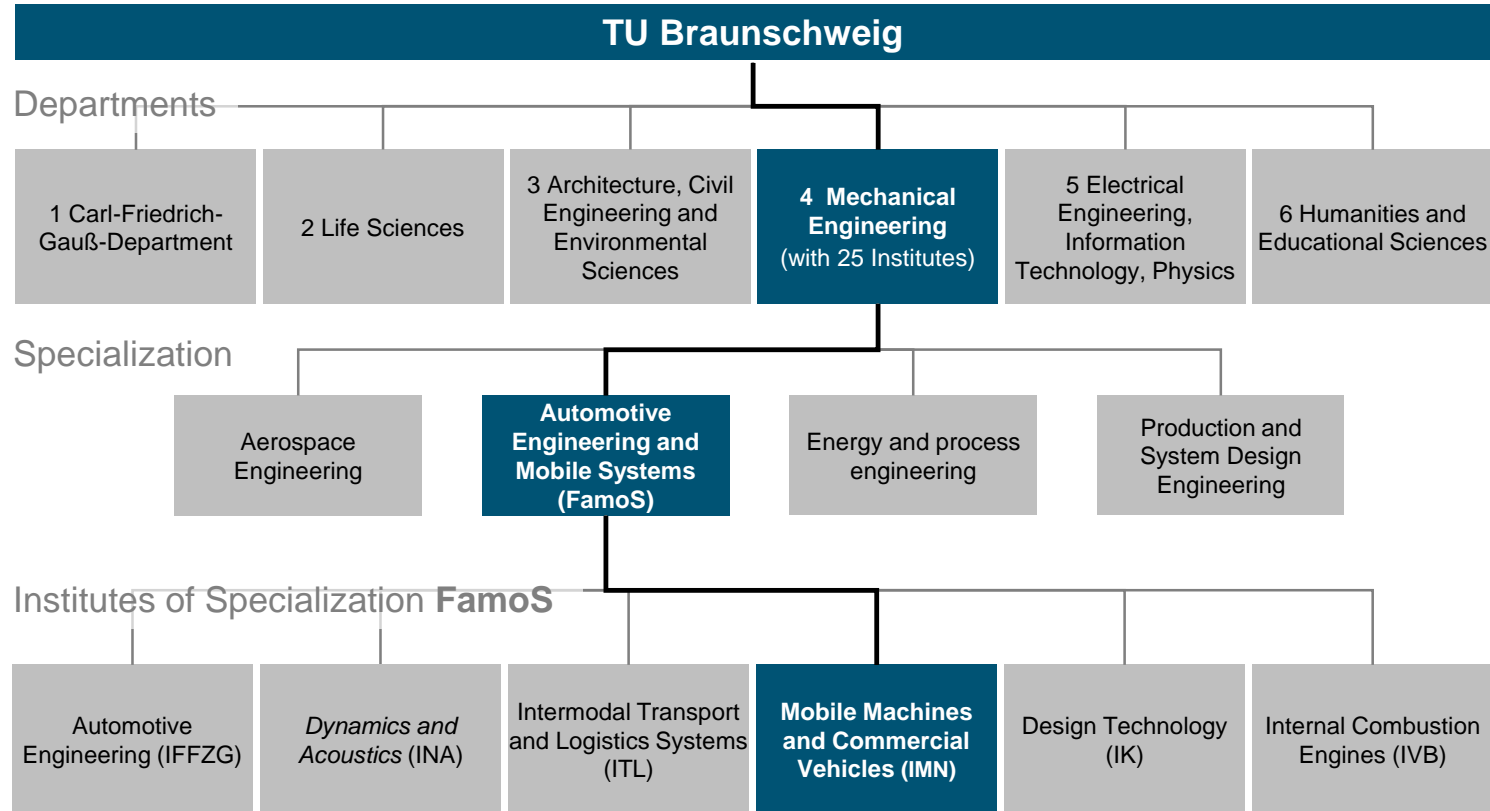
# Institute of Mobile Machines and Commercial Vehicles



# Content

- Organisation
- Research
- Education
- Equipment etc.

# The IMN in Context of the TU Braunschweig



# Fields of Activities



**Agriculture  
Engineering**



**Intralogistics**



**Construction  
Machinery**

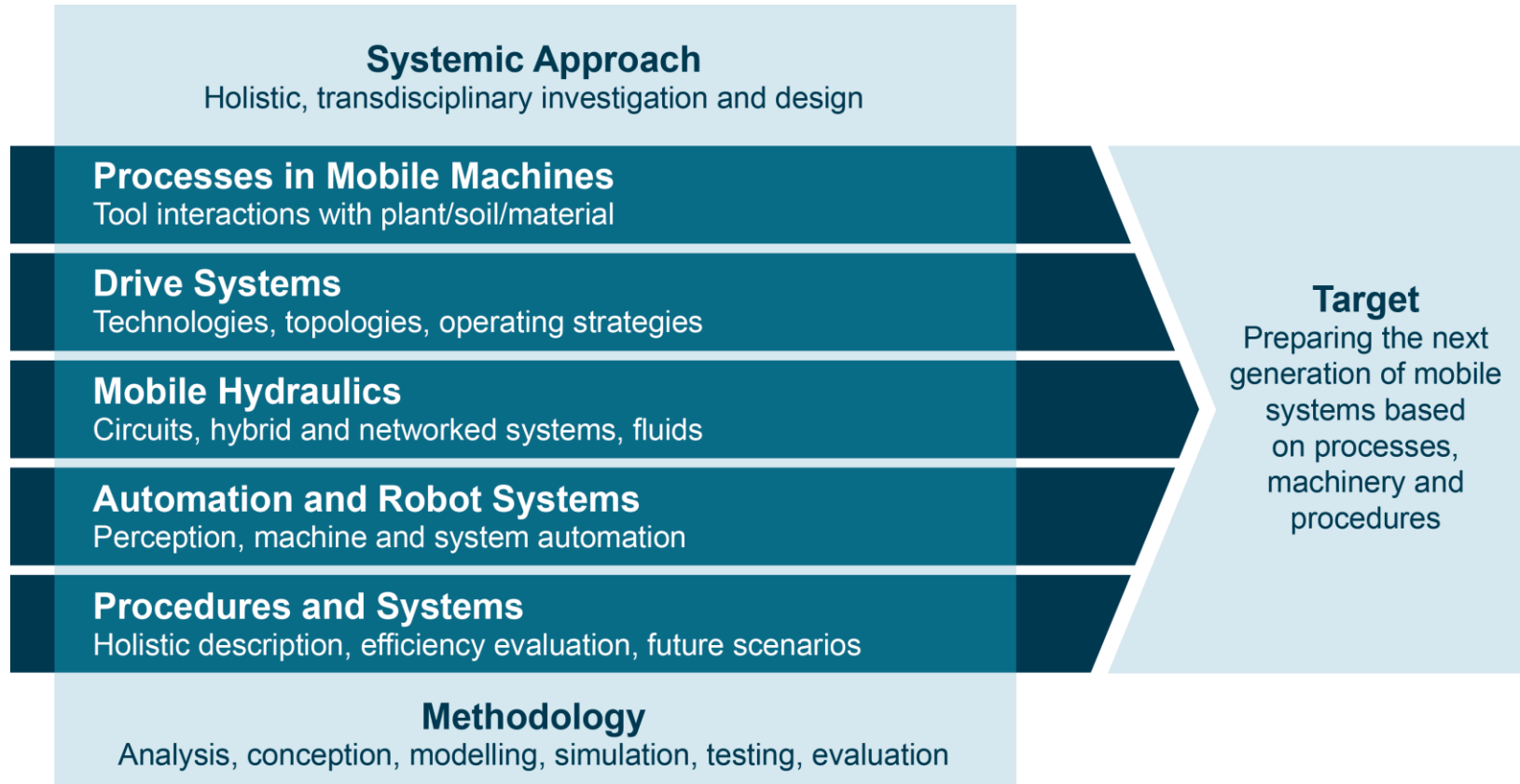


**Municipal  
Machines**



**Commercial  
Vehicles**

# Strategic Focus



# Research

- Organisation
- **Research**
- Education
- Equipment and further activities

# Topic: Processes in Mobile Machines

## Processes in Mobile Machines

Drive & Chassis Systems

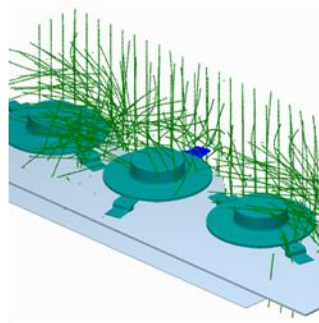
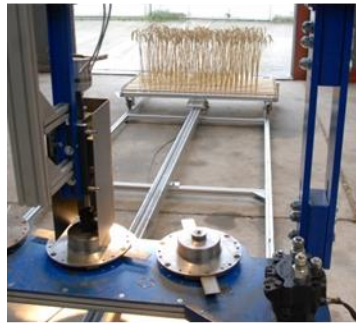
Mobile Hydraulics

Automation & Robot Systems

System Conception & Assessment

**„New processes and procedures to meet increasing quality and efficiency demands“**

- Investigation of process technologies
- Modelling and simulation of processes





# Selected Projects

Processes in  
Mobile Machines

Drive & Chassis  
Systems

Mobile  
Hydraulics

Automation &  
Robot Systems

System  
Conception &  
Assessment

Funded by:



## Study of process interactions of cultivation tools under high frequency excitation

### Background

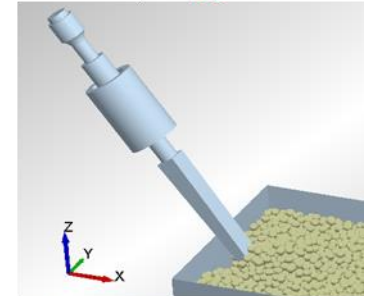
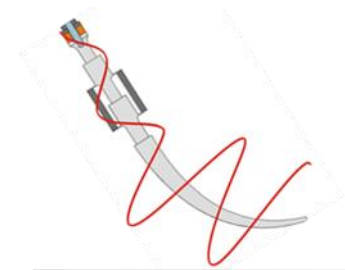
- High frequency oscillating cultivation tools are showing lower friction and resistance between the tool and soil.

### Aim

- Advanced study and numeric modeling of the tool-soil interaction

### Content

- Modeling and Simulation using DEM
- Validation of Simulation using a test rig
- Optimisation of the oscillating tool-soil-system regarding reduction of pulling forces





# Selected Projects

Processes in  
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## Simulation of a harvesting process with the discrete elements method

### Background

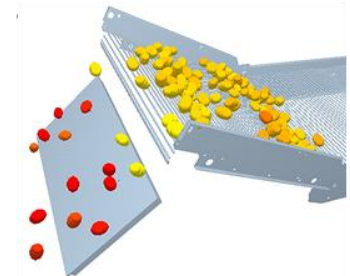
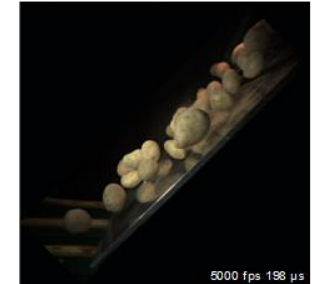
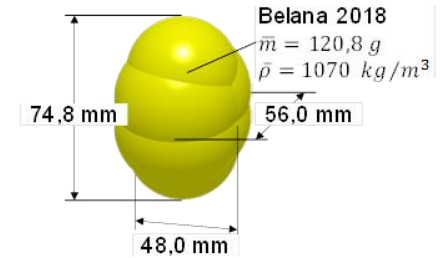
- Potato tuber damage reduces storability and saleability
- Time consuming optimisation of harvesting technology in field tests due to limited harvest time and changing environmental conditions

### Aim

- Supporting the development of new harvest technology with DEM-simulations to identify causes of high potato tuber stress even in conception phase

### Content

- Determination of mechanical and physical properties of potato tuber
- Development of tuber model for DEM-simulation
- Validation of simulation model



Funded by:

**GRIMME**

# Selected Projects

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Assessment

In cooperation with:



Funded by:



## Development of a prediction model and analyse of damage causing harvesting processes on potato tubers

### Background

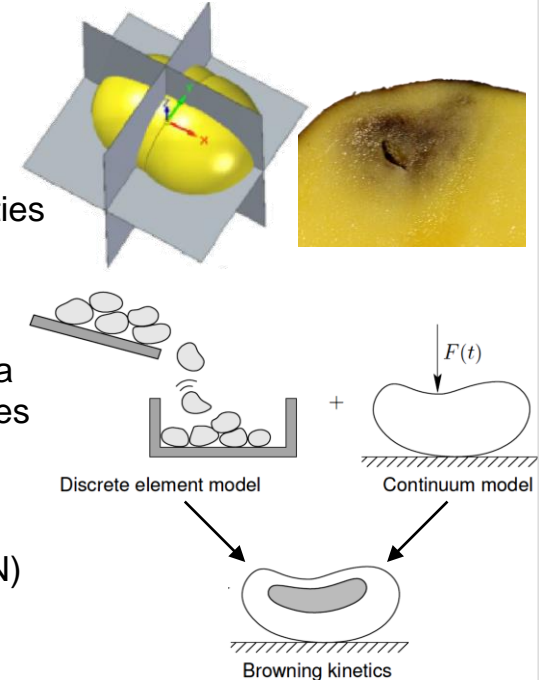
- Potato damage during harvest-, storage- and handling processes is unpredictable due to varying material properties of potato tubers

### Aim

- Non-destructive determination of internal tuber damage via an integrated model approach for identification of processes critical for damage

### Content

- Determination of impact loads in the harvesting chain (IMN)
- Building material model for elastic, viscous and plastic deformation via examination of impact behaviour (IFM)
- Integration of damage model in contact model for simulations with the discrete element method (IMN)



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## Integrated Material Modelling for Abrasion Resistant Steels

### Background

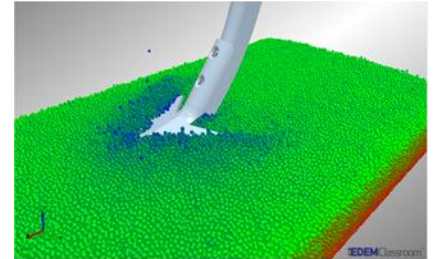
- Wear is an important economic factor with high annual costs
- Steels with improved abrasion resistance tend to suffer from relatively poor toughness

### Aim

- holistic multi-scale description of abrasion resistance of agricultural tillage equipment

### Content

- Identification of appearing loads in the tools
- Development of a methodology for parametrisation with the discrete element method (DEM)
- Validation and evaluation by series of tests in the soil bin



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Cooperation partners:



# Selected Projects

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Conception &  
Assessment

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## Innovative straw management with combi-mulcher

### Background

- Scientific investigation of an innovative process for advanced straw management in grain production

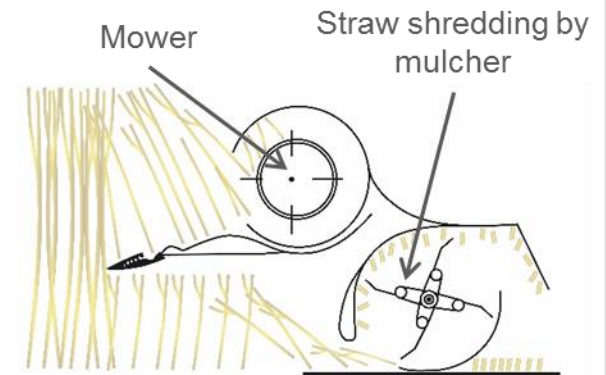
### Aim

- Testing of the practical suitability of a test machine for variable straw extraction with consideration of the technological and economic possibilities

### Content

- Division into individual processes and subsequent analysis
- Evaluation of different concepts of the entire machine
- Design and construction of a combi-mulcher
- Test execution and evaluation under real practical conditions

Cooperation partners:



High cut with  
combine

1<sup>st</sup> cut with  
combi-mulcher

2<sup>nd</sup> cut with  
combi-mulcher



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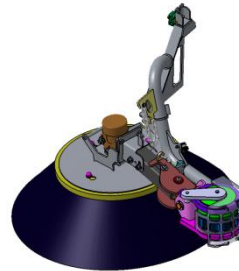
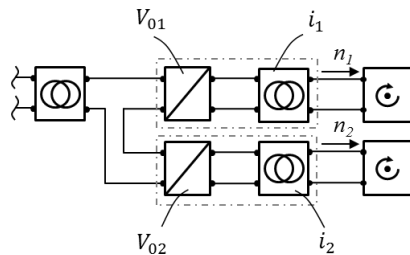
Mobile  
Hydraulics

Automation &  
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Conception &  
Assessment

## „Cross-technology powertrain development for traction and work drives“

- Drive topologies and system structures
- Design methods for cross-technology drives
- Operating strategies and powertrain management



# Selected Projects

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## Electric-hydraulic-mechanic Power trains for agriculture machinery with power supply via tractor interfaces

### Background

- Increasing area efficiency at equal or higher system and process efficiency
- Limited power supply of state-of-the-art tractor interfaces

### Aim

- Method to generate process-orientated EHM power trains and an external power supply
- Development and construction of a potato harvester prototype

### Content

- Evaluation of system architectures
- Automated system simulation

Cooperation partner: **GRIMME**

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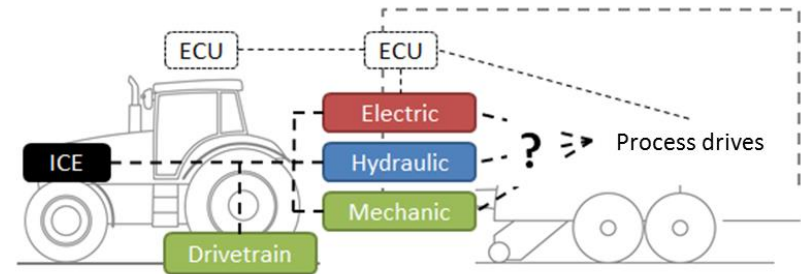
aufgrund eines Beschlusses  
des Deutschen Bundestages



rentenbank



Prothetische Braunschweig  
für Landwirtschaft und Ernährung



# Selected Projects

Processes in  
Mobile Machines

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Conception &  
Assessment

## Linear actuators with electric power supply

### Background

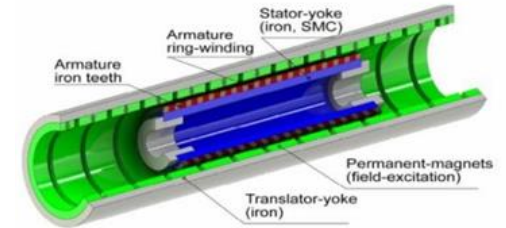
- Emission- and efficiency-driven trend towards the use of electric drives in mobile machines; implementation of translational movements so far using gears

### Aim

- Electrification of selected working drives with simultaneous improvement of process quality
- Functional verification of actuators in field use

### Content

- Design and testing of compact working drives using the example of an outdoor cleaning machine
- Energetic calculation of the electrified overall system



*Electric Linear Actuator [Institute for  
Electrical Machines, Traction and Drives]*

Funded by:



Cooperation partners: **IMAB** **OSWALD** **Hako**  
Clean ahead



# Selected Projects

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Conception &  
Assessment

## Fuel Cell Long Haul Truck

### Background

- EU climate targets cannot or only with difficulty be achieved with current drive technologies
- Use of hydrogen in fuel cells as local emission-free drive has not been widespread so far due to lack of infrastructure

### Aim

- Construction of a long haul truck with fuel cell drive and a self-sufficient hydrogen filling station

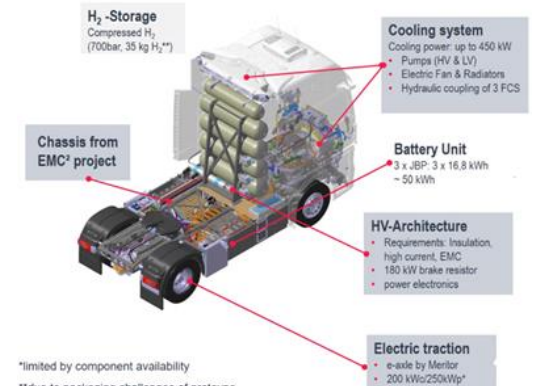
### Content

- Development of drive and refueling concept
- Optimization control strategy
- Realization in laboratory and demonstrator

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Cooperation partners:



# Selected Projects

Processes in  
Mobile Machines

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Mobile  
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Automation &  
Robot Systems

System  
Conception &  
Assessment

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**N**Bank

## BETH<sub>2</sub>REX

### Battery Electric Truck with H<sub>2</sub> Range Extender

#### Background

- E-trucks are locally emission-free and low-noise
- H<sub>2</sub> Range Extender: long range without fossil fuels

#### Aim

- Development of an electric truck with fuel cell range extender for urban logistics
- Development of operating strategies for energy management
- Vehicle valuation and fleet optimization

#### Content at IMN

- Creation of a complete vehicle model
- Development and optimization of operating strategies
- Logistics simulations for the derivation of application profiles and driving cycles
- Evaluation of vehicles with regard to electricity and hydrogen consumption
- Optimization of operating strategies and fleet composition

Cooperation partners:



# Topic: Mobile Hydraulics

Processes in  
Mobile Machines

Drive & Chassis  
Systems

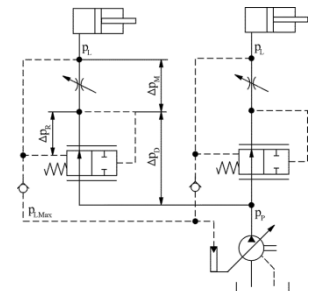
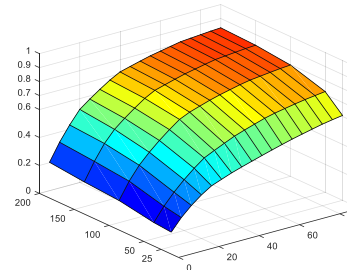
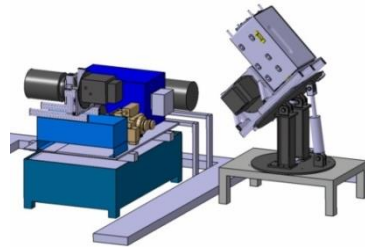
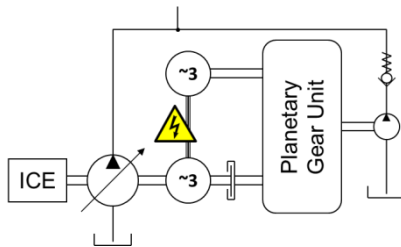
**Mobile  
Hydraulics**

Automation &  
Robot Systems

System  
Conception &  
Assessment

## „Hybrid and data-networked systems“

- Design and testing of novel hydraulic circuits
  - Mechatronic system integration
  - Component and fluid investigations



# Selected Projects

Processes in  
Mobile Machines

Drive & Chassis  
Systems

**Mobile  
Hydraulics**

Automation &  
Robot Systems

System  
Conception &  
Assessment

## Development of glycerol/chitosan-based fluids for drive systems in mobile and stationary hydraulics

### Background

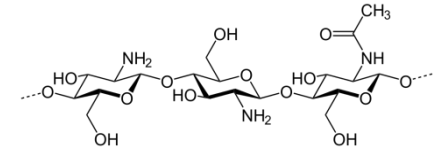
- Substitution of mineral oil-based fluids by environmentally compatible alternatives in various technical applications
- Use of co-products from bioprocesses in the fluids

### Aim

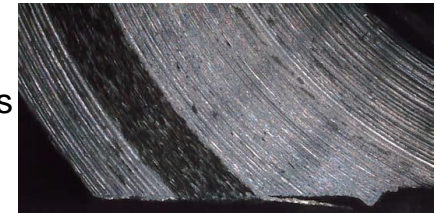
- Modular development for practical glycerin/chitosan-based fluids in mobile and stationary hydraulic systems

### Content

- Formulation of fluid variants for different technical applications
- Conceptual design and operation of application-oriented hydraulic systems to check the suitability of various fluid variants
- Identification of the design potential of corresponding hydraulic systems with glycerin/chitosan-based fluids



Structural formula of the biopolymer and central fluid component chitosan



Wear assessment on the contact surface gland bearing / gear wheel

Cooperation partners:



Institut für Ökologische  
und Nachhaltige Chemie

**Oemeta**  
The Coolant Company

**BUCHER**  
HYDRAULICS

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aufgrund eines Beschlusses  
des Deutschen Bundestages



# Selected Projects

Processes in  
Mobile Machines

Drive & Chassis  
Systems

**Mobile  
Hydraulics**

Automation &  
Robot Systems

System  
Conception &  
Assessment

## Electric-hydraulic hybrid in closed circuit

### Background

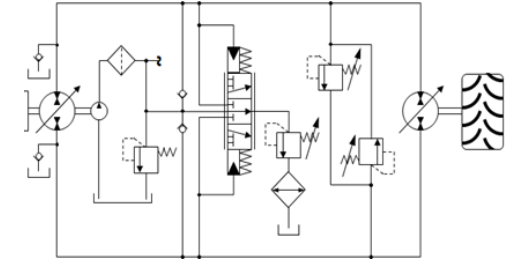
- Boost function in closed circuit with auxiliary pump with constant displacement
- Application without demand oriented boost function

### Aim

- Efficiency increase of hydrostatic drives in closed circuit by optimizing the application for boost function

### Content

- Investigation of different approaches to the use of energy from the supply circuit
- Proof of function and saving potential by simulation and test bench application



Circuit diagram of a closed circuit



Example machine: Komatsu WA80M

Funded by:



Supported by:    

# Selected Projects

Processes in  
Mobile Machines

Drive & Chassis  
Systems

**Mobile  
Hydraulics**

Automation &  
Robot Systems

System  
Conception &  
Assessment

## Integrated supply

### Background

- Pure hydraulic power transfer in current traction drive (less efficient)
- No bidirectional hydraulic power flow between the drive and working hydraulic systems

### Aim

- Development of power split transmission with integrated supply for working hydraulics

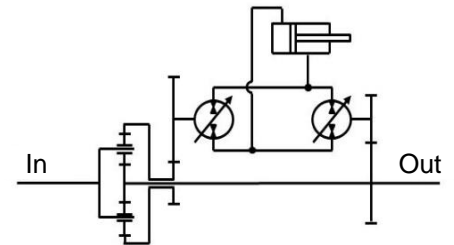
### Content

- Development of optimal system topology
- Implementation of suitable operating and control strategies for the power split transmission
- Proof of function and saving potential by means of simulation and experiment

Supported by:     



Example vehicle: Komatsu WA 70-5 (45 kW)



Schematic of the system

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# Topic: Automation and Robot Systems

Processes in  
Mobile Machines

Drive & Chassis  
Systems

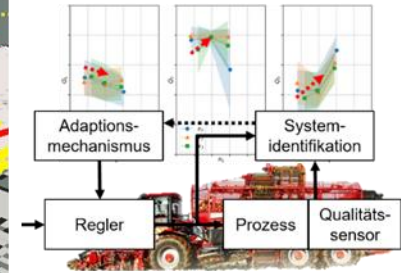
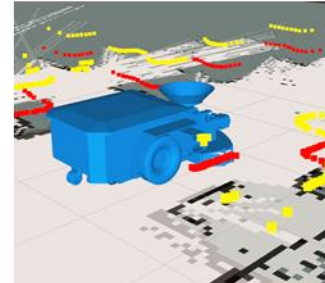
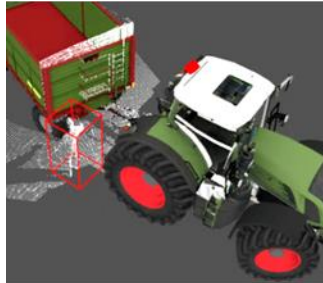
Mobile  
Hydraulics

Automation &  
Robot Systems

System  
Conception &  
Assessment

## „Automation of mobile machines and systems“

- Environment Perception - Sensor Data Interpretation & Localization
  - Flexible communication structures
  - Machine and system automation





# Selected Projects

Processes in  
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System  
Conception &  
Assessment

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## Further development of the control module for the automation of a mobile machine for the dairy farming

### Background

- Rising costs requires an increasing degree of automation
- Improve the animal health by automated cleaning

### Aim

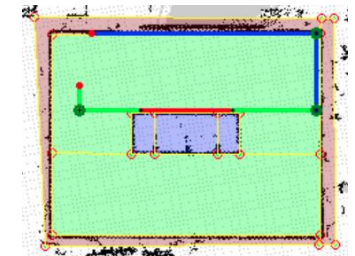
- Automation of the tasks: Cleaning the running surface and maintaining of the cubicles

### Content

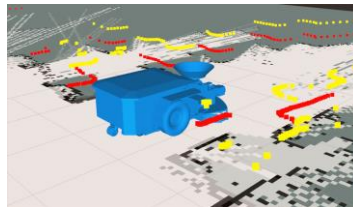
- SLAM and localization with two 2D lidars
- Path planning and collision avoidance



CAD robot model with lidar field of view



Semantic map and path planning



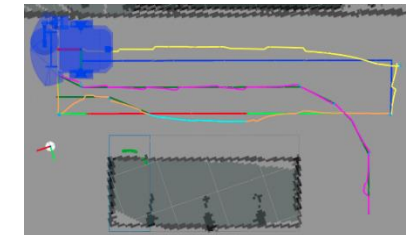
Localization with two 2D lidars



Cooperation partners



Eurotier 2018 Silver Medal



Experiment in an artificial stall barn

# Selected Projects

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Conception &  
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## ANKommEn - Automated Navigation and Communication for Exploration

### Background

- To coordinate rescue teams as effective as possible, a fast and precise information acquisition is beneficial

### Goal

- An automated exploration system to increase situation awareness of rescue teams

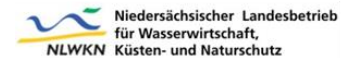
### Work contents

- Fully automated control of unmanned air and ground systems
- Swarm positioning due to exchange of GNSS code and phase measurement
- Survey of environment due to visual sensors and fusion of sensor data into a common map
- Development of communication structures for mobile data exchange



*Distributed Exploration System  
for Rescue Forces*

Cooperation Partners:



Funded by:



aufgrund eines Beschlusses  
des Deutschen Bundestages

# Selected Projects

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des Deutschen Bundestages



ptble  
Projektträger Bundesamt  
für Landwirtschaft und Ernährung



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## Adaptive control of the harvesting and cleaning organs of a beet harvester

### Background

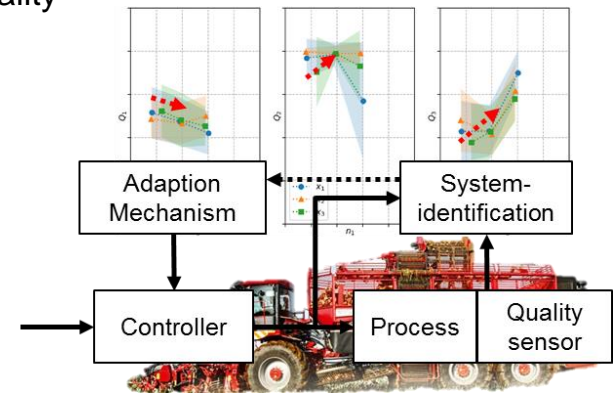
- Permanent and high load for drivers of harvesting machines during harvesting time
- Optimum harvesting results depend on the varying harvesting conditions

### Target

- Development of an expert/assistance system to relieve the driver when setting up the harvester work contents

### Work contents

- Development of a method for assessing process quality
- Identification of the interaction between harvester and environment
- Development and testing of the expert/assistance system in practical use



Cooperation partner: **HOLMER** **exxact** **E** CLK GmbH  
Robotik & Bildverarbeitung

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Conception &  
Assessment

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## KibEZ AI-based yield determination of sugar beets

### Background

In sugar beet cultivation, exact yield mapping has not been possible so far. However, it is necessary for precision farming and a resource-saving transport chain from the field to the sugar factory.

### Aim

The development and validation of an AI-based yield measurement system that generates a yield map based on the machine state values of the beet harvester.

### Content

- Recording of training and reference data during field tests.
- Mapping expert knowledge into a machine learning algorithm.
- Optimization and validation of the AI-based yield measurement system.



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## Project 5G Smart Country Use Case: Smart Farming



### Background

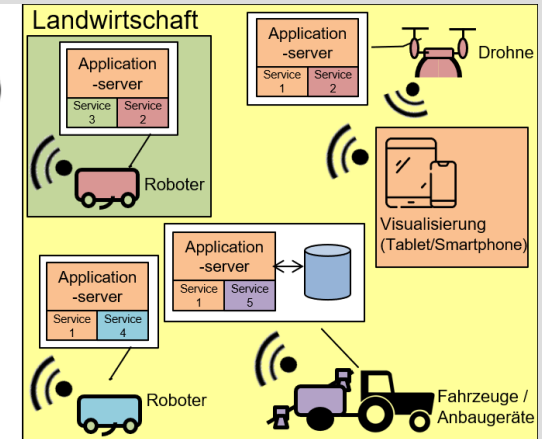
- Agriculture is a core challenge due to ensure a secure food supply for a growing population despite land degradation, climate change and resource scarcity

### Aim

- Data-based applications should increase the social-acceptance of an efficient, transparent and sustainable agriculture

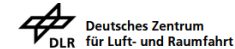
### Content

- Cooperative use of field robots and UAVs
- Detection of weed nests
- Mechanical weed control
- Implementation of Spot-Farming approaches through variable seeding
- Detection of wildlife



Smart Farming and all Use Cases  
connected by 5G

Selection of project partners:





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Conception &  
Assessment

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Bundesministerium  
für Bildung  
und Forschung

## Electronic system for localization based on ground penetrating radar data



### Background

- Current GNSS and optical sensors cannot guarantee localization either in 24/7 operation or in all application areas
- Ground penetrating radars (GPR) measure long-term stable and unique subsurface structures

### Aim

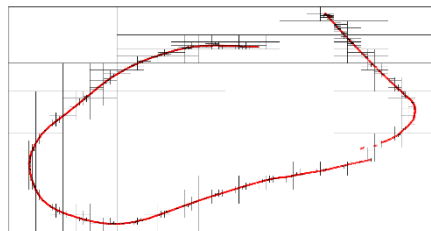
- Development of a vehicle localization algorithm for a stepped-frequency GPR with a multi-antenna array.

### Content

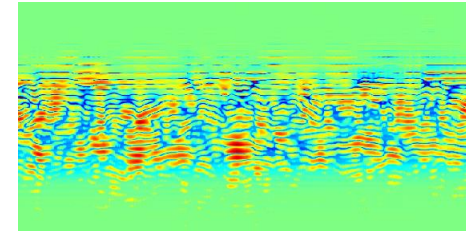
- Localization on routes (e.g. a street) and areas (e.g. company yards)



*Project robot*



*Quadtree-based map*



*Measurement with a GPR*

# Selected Projects

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Assessment

Funded by:



## Project MODEFY Monitoring and DEfence against Yellows virus

### Background

- The ban on neonicotinoids in 2019 has resulted in the increased occurrence of the viral yellowing virus, which is ultimately associated with significant yield losses.

### Aim

- The main goal of the project is the development of resistant sugar beet varieties by the participating seed producer.
- In addition, natural beneficial insects should be used to control the causal infectious pests.

### Content

- Application of pests and beneficial insects within the scope of variety trials of the seed producer
- Detecting yellowing spots in the field by UAV
- Targeted application of beneficial insects in yellowing spots



*Spots as a consequence of yellow virus within a field of sugar beets*

Project partner:



INRAE





# Topic: System Conception and Assessment

Processes in  
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Automation &  
Robot Systems

**System  
Conception &  
Assessment**

## „Concepts for sustainable machinery, tractor & trailer and fleets“

- Identification of requirements and description of operation profiles
  - Definition of evaluation criteria
- Feasibility studies for system and vehicle solutions
- Scientific support in implementing the concepts



# Selected Projects

Processes in  
Mobile Machines

Drive & Chassis  
Systems

Mobile  
Hydraulics

Automation &  
Robot Systems

**System  
Conception &  
Assessment**

## Energy4Agri – Holistic concept and modelling of agricultural systems with regenerative energy supply

### Background

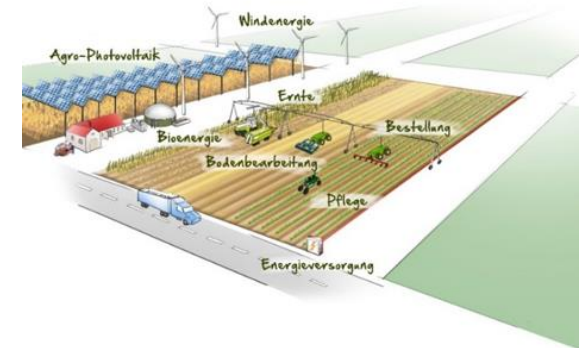
- Challenges in the context of the use of renewable energy sources in agricultural technology

### Aim

- Design and modelling of concepts for agricultural systems with regenerative energy supply for decarbonisation of agriculture

### Content

- Determination and simulation of required power and energy requirements of the current agricultural field management
- Analysis and simulation of the current energy generation and supply with energetic models and grid calculations
- Modelling of future scenarios for the evaluation of possible system change with regard to various technical, ecological and social aspects



Scientific partners:



Funded by:



aufgrund eines Beschlusses  
des Deutschen Bundestages



# Selected Projects

Processes in  
Mobile Machines

Drive & Chassis  
Systems

Mobile  
Hydraulics

Automation &  
Robot Systems

System  
Conception &  
Assessment

## EKoTech – Efficient fuel use in agricultural technology

### Background

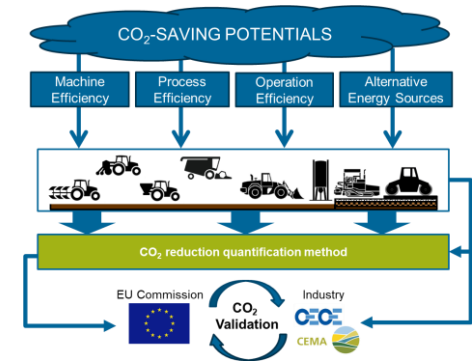
- Holistic consideration of the use of technology in the production process to reduce greenhouse gas emissions
- Consideration of machine and process efficiency, efficiency through operation, use of alternative energy sources

### Aim

- Determination of potentials for increasing fuel efficiency in agricultural process chains
- Development of region-specific recommendations

### Contents

- Establishment of a “Qualified Efficiency” for the evaluation of process steps with regard to process performance and quality
- Development of a model to calculate the fuel consumption of model farms and selected scenarios



Concept for the voluntary commitment of manufacturers of construction and agricultural machinery

Partners:



Funded by:



aufgrund eines Beschlusses  
des Deutschen Bundestag

# Selected Projects

Processes in  
Mobile Machines

Drive & Chassis  
Systems

Mobile  
Hydraulics

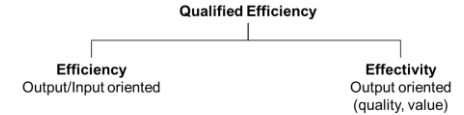
Automation &  
Robot Systems

System  
Conception &  
Assessment

## EKoTech – Work package “Qualified Efficiency”

- Development of a method to evaluate the effectiveness and efficiency of agricultural processes and procedures
- Measurement of parameters determining the quality of work by means of extensive sensor technology and validation of the method

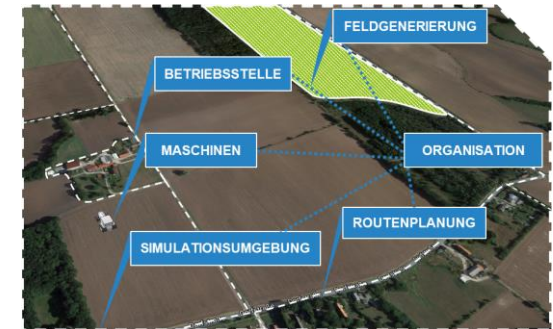
	Effective	Ineffective
Efficient	++	-
Inefficient	o	--



**Qualified Efficiency**  
Ratio between the achieved result and the resources used, taking into account an output quality

## EKoTech – Work package “Simulation model”

- Development of a process model to calculate the required times of individual subtasks in the operational profile of a machine
- Integration of the process model and further single machine models into an overall model for mapping development scenarios



Model to calculate the partial times of a process step

Funded by:



aufgrund eines Beschlusses  
des Deutschen Bundestag

# Selected Projects

Processes in  
Mobile Machines

Drive & Chassis  
Systems

Mobile  
Hydraulics

Automation &  
Robot Systems

**System  
Conception &  
Assessment**

## Center for Digital Innovations Lower Saxony - Future Laboratory Agriculture

### Background

- As in every field of application, the digitalisation of agriculture requires the technical permeability of the value networks concerned for the data generated
- Conflict between data transparency in the value network and data sovereignty

### Aim

- Concepts for technical and legal data protection for protected transparency
- Quantification of sustainability effects in the context of the digitalisation of agriculture

### Content

- Analysis of data records and data flows in agriculture
- Practice-oriented autonomisation of agricultural processes
- Sustainability of digitalisation in agriculture in Lower Saxony
- Public relations work, including training and teaching and advice

Funded by:



from the budget of  
Niedersächsisches Vorab



Scientific partners:



# Selected Projects

Processes in  
Mobile Machines

Drive & Chassis  
Systems

Mobile  
Hydraulics

Automation &  
Robot Systems

System  
Conception &  
Assessment

## With autonomous agricultural machinery to new crop production systems

### Background

- Driverless machines offer enormous potential for innovative crop production systems
- Holistic development of new crop production systems necessary
- Input from Technology, Agricultural Sciences and Economics

### Aim

- Methodically developed scenarios for novel crop production systems with autonomous machines

### Content

- Analysis of crop cultivation requirements
- Development of innovative robot concepts
- Calculations of variations of procedures and processes with regard to the use of autonomous robots
- Linking of parameters from technology, crop production and business management



Robots for plant care



Autonomous grain harvest

Scientific partners:



Funded by:

Gefördert durch:



Bundministerium  
für Ernährung  
und Landwirtschaft

BÖLN

Technische Universität  
Braunschweig

aufgrund eines Beschlusses  
des Deutschen Bundestages



# Selected Projects

Processes in  
Mobile Machines

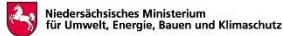
Drive & Chassis  
Systems

Mobile  
Hydraulics

Automation &  
Robot Systems

**System  
Conception &  
Assessment**

Funded by:



Cooperation partners:



## H2Agrar - Development of green hydrogen mobility for the agricultural state of Lower Saxony

### Background

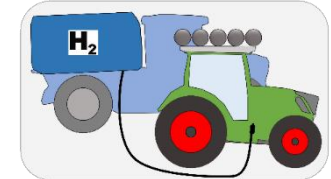
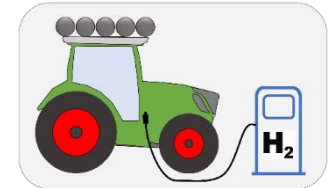
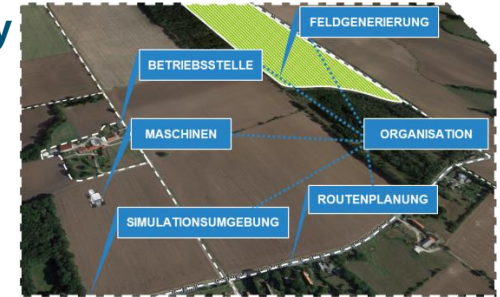
- Use of green hydrogen in tractors

### Aim

- Provision and distribution of green hydrogen generated regionally in wind farms
- Development and testing of a hydrogen-powered tractor in agricultural process chains
- Prospects for further hydrogen applications

### Content

- Modeling and simulation using agent-based process simulation
- Investigation of refueling variants for the hydrogen tractor
- Evaluation of hydrogen supply concepts





# Selected Projects

Processes in  
Mobile Machines

Drive & Chassis  
Systems

Mobile  
Hydraulics

Automation &  
Robot Systems

**System  
Conception &  
Assessment**

Funded by:



Research partner:



## RegEnerMoBio – Regenerative energy supply for off-grid mobility through biogas plants

### Background

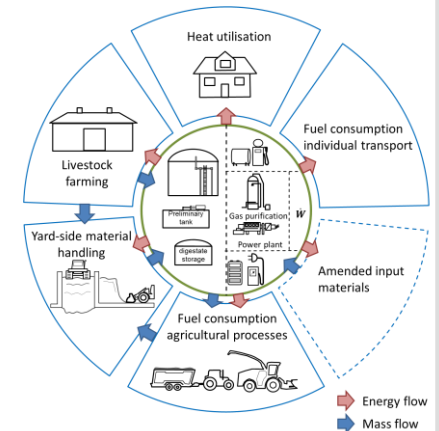
- Conversion of the energy system to 100 % renewable energy sources
- Economically efficient use of biogas plants after expiry of the guaranteed remuneration rates by the EEG

### Aim






- Economically optimal provision of heat and energy for the mobility sector through existing biogas plants
- Evaluation of suitable drive concepts for agricultural machines and private transport under a holistic view of the biogas plant

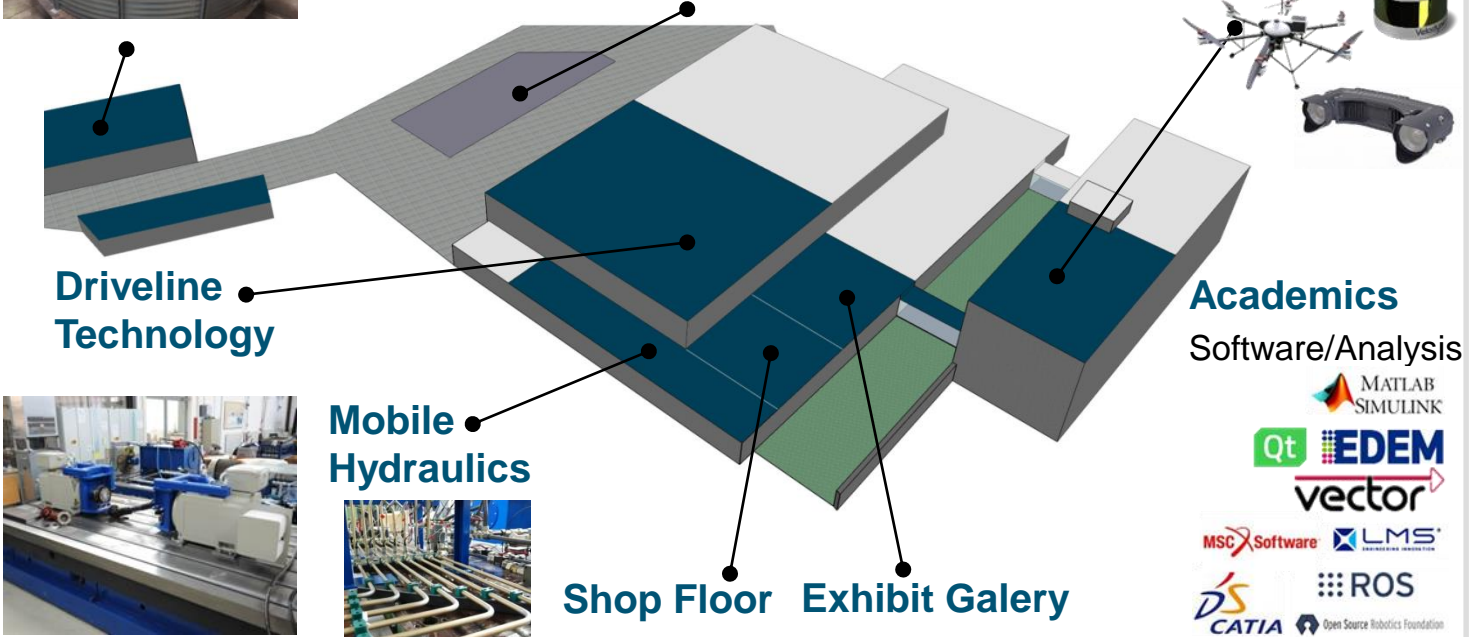
### Contents IMN

- Integration of relevant farm processes for operating a biogas plant in the process simulation (Verfahrenssimulation)
- Determination of the biogas requirements of agricultural machines



# Equipment

Equipment	<b>Process Technology</b>	<b>Test Areas and Vehicles</b>		<b>Test Areas and Vehicles</b>
Courses				
Project and final theses				
Lab Courses				
Additional				
Further Activities				

**Driveline Technology**

**Mobile Hydraulics**

**Shop Floor**

**Exhibit Gallery**

**Academics**  
 Software/Analysis

- MATLAB SIMULINK
- Qt EDEM
- vector
- MSC Software
- LMS
- ROS
- CATIA
- Open Source Robotics Foundation

# Equipment

## Equipment

Courses

Project and final theses

Lab Courses

Additional

Further Activities

## Test stand floor channel for endurance tests

- Drive power 44 kW, speeds up to 15 km/h
- Stations: Measuring point, loosening, reconsolidation
- 3-axial force measuring frame (3 x forces, 3 x moments)
- Piezo measuring elements for load profile measurement on the tool



## Soil quality measurement

- Automated evaluation of straw coverage, surface evenness and clod size



## High-speed recoding

- Process analysis through slow motion evaluation
- Determination of the contact force-elongation of agricultural crops

# Equipment

Equipment
Courses
Project and final theses
Lab Courses
Additional
Further Activities

## Experimental robot Summit-XL

- Drive: 4 x 250 W brushless servo motors
- Driving data: up to 3 m/s and 80% gradient
- 20 kg payload and empty weight of 45 kg
- Operating time of up to 5 h with LiFePo4 15 Ah battery
- Communication hardware, positioning and environmental sensors
- Modular Softwareframework ROS



## Test tractor for tractor automation Fendt Vario 724

- Mounting options for various environmental sensors
- Electronically controllable via CAN bridge
- Access to steering, travel drive and working hydraulic



## Other equipment

- 2D and 3D cameras, including Multisense S21
- 2D and 3D laser scanners, including Velodyne VLP16, Sick TIM571 and MRS1000
- Robotics arm, Deep Learning Workstations, nVidia Jetson Boards, etc.
- Drones DJI M30T & M300 with L1 and MicaSense sensors

# Equipment

Equipment

Courses

Project and final theses

Lab Courses

Additional

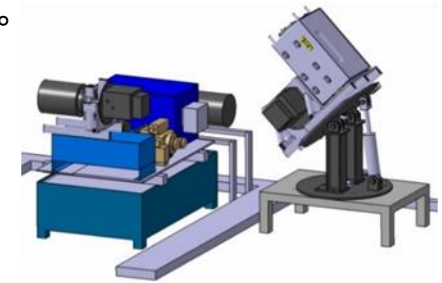
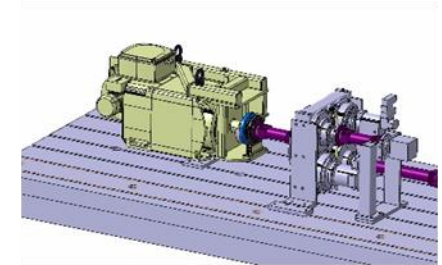
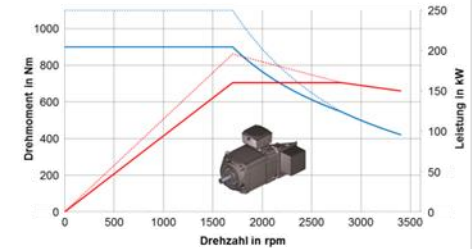
Further Activities

## Primary drive and load units for powertrain investigations

- Rated Power: 2x 165 kW
- Rated Speed: 1750 min<sup>-1</sup>
- Nominal torque: 900 Nm
- Angular acceleration: 604 rad/s<sup>2</sup>
- Speed measurement: analogue, sin/cos, 2048 periods
- Torque measurement: analogue, accuracy class 0.05
- 4-quadrant operation with electrical regenerative power

## Test facilities for working hydraulic systems

- Electric drives up to 40 kW and 3000 min<sup>-1</sup>
- Conditioning options for hydraulic fluids
- Test platform can be tilted up to 40°, tilt axis can be rotated 360°
- Analysis of various types of loads, pressure pulsations, air separation in the tank
- Map measurement of hydrostats and valves



# Courses in Bachelor and Master Programs

Equipment	<b>Bachelor Mechanical Engineering (B.Sc.)</b> <ul style="list-style-type: none"><li>▪ Fundamentals of Complex Machine Elements and Drive Systems</li><li>▪ Mobile Machines and Commercial Vehicles</li></ul>
Courses	
Project and final theses	<b>Master Automotive Engineering (M.Sc.)</b> <ul style="list-style-type: none"><li>▪ Driveline Technologies (Power transmission)</li><li>▪ Hydraulic Fundamentals and Components</li><li>▪ Hydraulics Circuits and Systems</li><li>▪ Hydraulics Modeling and Controlled Systems (Dr. Jan Schattenberg)</li><li>▪ Heavy commercial vehicles</li><li>▪ Automation of mobile Machines (Dr. Jan Schattenberg)</li><li>▪ Agricultural technology - Basics and Machines</li><li>▪ Agricultural technology - Processes, Machines, Procedures</li><li>▪ Plant protection technology (Prof. Dr. Jens Wegener, Julius-Kühn-Institute)</li><li>▪ Smart Farming (Prof. Dr. Christina Umstätter, Thünen-Institute)</li></ul>
Lab Courses	
Additional	
Further Activities	
	<b>Supervision of Projects, Bachelor and Master Thesis</b>



# Project and final Theses

Equipment

Courses

**Project and final theses**

Lab Courses

Additional

Further Activities

## Project and final Theses

In the Bachelor's and Master's degree programs in Mechanical Engineering at the TU Braunschweig, various student projects must be completed in group or individual work during the course of study. In the Bachelor's program, these include the project and bachelor's thesis. In the master's program, the student research project and the master's thesis must be successfully completed. The IMN offers a variety of different topics for this. In addition, the IMN also supervises student theses that are written in industrial companies or in research facilities other than the institutes of the Technische Universität Braunschweig and thus supports students who want to gain practical insights into the activities and structures of potential employers.

A selection of internal topics can be found digitally on our website under Teaching.

# Lab Courses

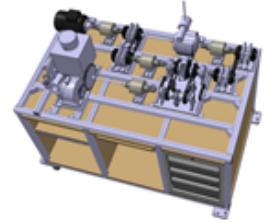
Equipment
Courses
Project and final theses
<b>Lab Courses</b>
Additional
Further Activities

## Laboratories and teaching equipment

The following laboratories are offered to students:

- Oil Hydraulics - Fundamentals (Bachelor, WS)
- Elements of Drive Technology for Mobile Machinery (Bachelor, WS)
- Oil hydraulics - critical operating points in extended system circuits(Master, SS)
- Power flows in a hydr.-mech. power split transmission(Master, WS)
- Tractor workshop (independent of course of studies, SS)

Test rigs are available for the laboratories and lecture courses in the fields of drive technology, mobile hydraulics and robotics. In addition, a computer room with various software packages and various laboratory rooms are used for individual and group work. An extensive model collection of agricultural and drive technology exhibits completes the teaching equipment of the IMN.



# Lab Courses

Equipment

Courses

Project and final theses

**Lab Courses**

Additional

Further Activities

## Practice-Tractor-Course

### Theory

- Basics, assistance systems, design and operating rules

### Practice

- Driver training at the ADAC traffic training area
- Machine practice with tillage equipment

Further information:

[www.tu-braunschweig.de/imn](http://www.tu-braunschweig.de/imn)



# Student Groups

Equipment
Courses
Project and final theses
Lab Courses
<b>Additional</b>
Further Activities

## FREDT - Field Robot Event Design Team

- Development of autonomous field robots
- Participation in the international Field Robot Event (FRE)
- Projects in the areas of design, sensor technology, navigation as well as programming and electronics

Current work and content:

- Use of the ROS framework for sensor data processing, vehicle control and for simulation
- Development and design of new attachments
- Optimization of the new "HELIOS evo" field robot
- Defense of the FRE - world champion title

Contact: Dr.-Ing. Jan Schattenberg  
Website: [www.fredt.de](http://www.fredt.de)



Team picture

# Further Activities

Equipment

Courses

Project and final theses

Lab Courses

Additional

Further Activities

## Freundes- und Förderkreis des Instituts für mobile Maschinen und Nutzfahrzeuge e.V.

- Non-profit association to promote research and science
- Support of young academics and scientists (attendance of conferences, study trips, equipment acquisition etc.)
- Release of scientific books and papers (e.g. dissertations, proceedings)
- Alumni networking
- Publication of biannual newsletters with up-to-date information from the institute and on projects

Chairman: Prof. Dr. Carsten Intra (VW)

Second Chairman: Dr.-Ing. Jan Schattenberg

Director: M.Sc. Christian Depenbrock



Alumni meeting at the IMN



Mobile Machine day



# Further Activities

Equipment

Courses

Project and final theses

Lab Courses

Additional

Further Activities

## JAHRBUCH AGRARTECHNIK

YEARBOOK AGRICULTURAL ENGINEERING



„So jemand bewirkt, dass dort zwei Halme wachsen, wo zuvor nur einer stand, hat er mehr für das Vaterland getan als ein General, der eine siegreiche Schlacht schlug.“  
Friedrich der Große (1712 - 1786)

Issue: 2017

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# Contact



Technische Universität Braunschweig  
Institute of Mobile Machines and  
Commercial Vehicles

Langer Kamp 19a  
38106 Braunschweig

Tel.: +49 (0) 531 391-2670

Fax: +49 (0) 531 391-5951

[imn@tu-braunschweig.de](mailto:imn@tu-braunschweig.de)

[www.tu-braunschweig.de/imn](http://www.tu-braunschweig.de/imn)