Furtwangen University (HFU)
The Black Forest University

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HFU Powertrain & Machine Validation Laboratory

The Black Forest University

Engineering

Computer Science

Business Information Systems

Fields of study at Furtwangen University

Business Administration and Engineering

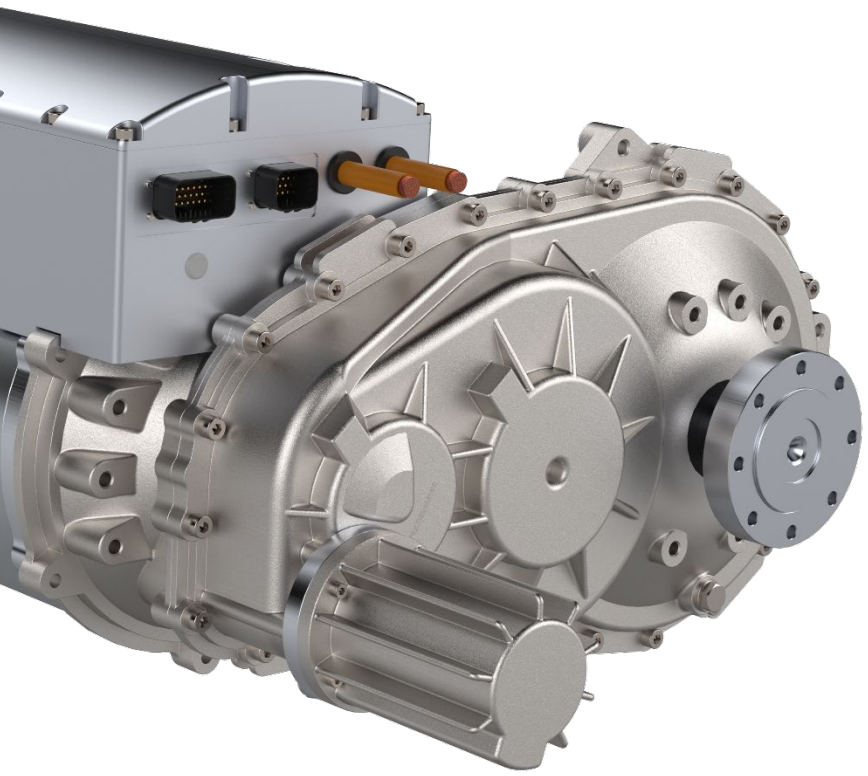
Digital Media

International Business

Health | Life Sciences

The Black Forest University

HOCHSCHULE FURTWANGEN UNIVERSITY | HFU



Institute for Product and Service Engineering (IPSE)

Powertrain and Machine Validation Laboratory (PMVL)

Research Group PMVL

- **P**owertrain and **M**achine **V**alidation **L**aboratory

- Research Focus:

  Methods and **process models** for the **validation** of **technical systems**

Core Team

Prof. Dr.-Ing. Steffen Jäger
Professor at HFU since 2018 Founder and head of PMVL since 2020
M.Sc. in Mechanical Engineering Ph.D. at the Karlsruhe Institute of Technology (KIT)

Tilmann Linde, M.Sc.
Research Associate since 2021
M.Sc. in Mechanical Engineering

Kai von Schulz, M.Sc.
Research Associate since 2022 PhD candidate at the Karlsruhe Institute of Technology (KIT)
M.Sc. in Mechanical Engineering

Dr. rer. nat. Sven Roth
Research Associate since 2024
M.Sc. (Diplom) in Geology Ph.D. at Institute for Marine Geosciences, Kiel

Our Expertise

- Methods and process models for the **validation of technical systems**
- Physical/virtual coupled **validation of powertrain systems** and their components
- 3D FEA/MBD: linear/nonlinear structural mechanical, **dynamic analyses** (modal/frequency response)
- Multi-domain **1D-simulation** of powertrain systems (e.g. with detailed gear data consideration)
- **3D acoustic simulation** coupled with 1D system simulation results (for structure- and air-borne sound)

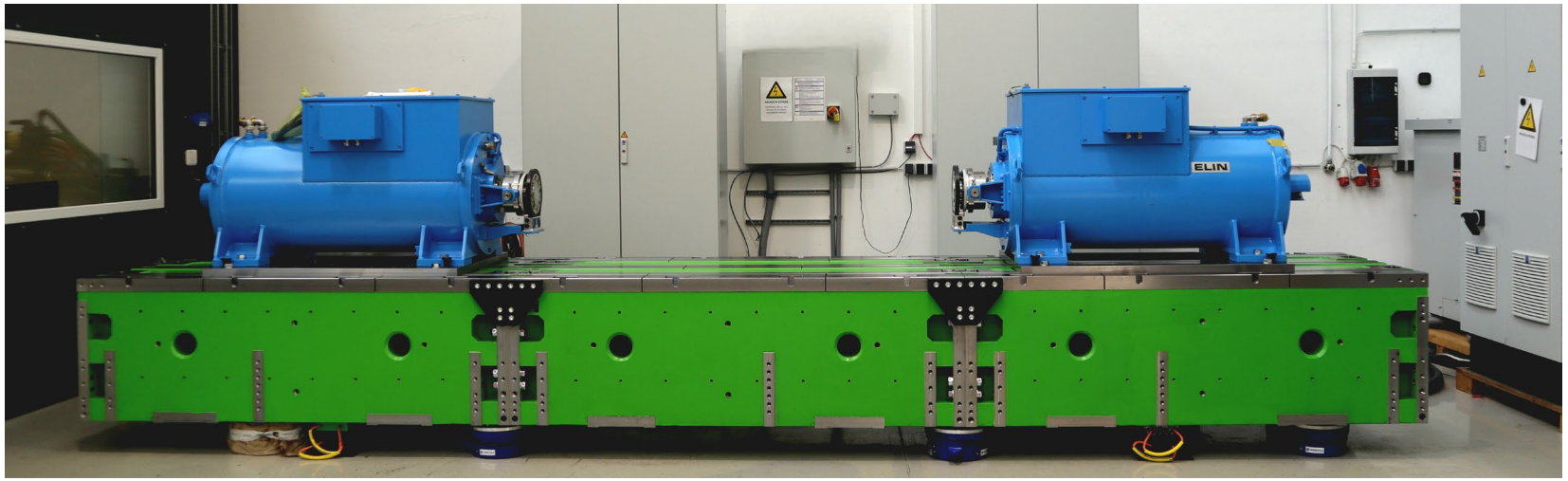
Lab Equipment

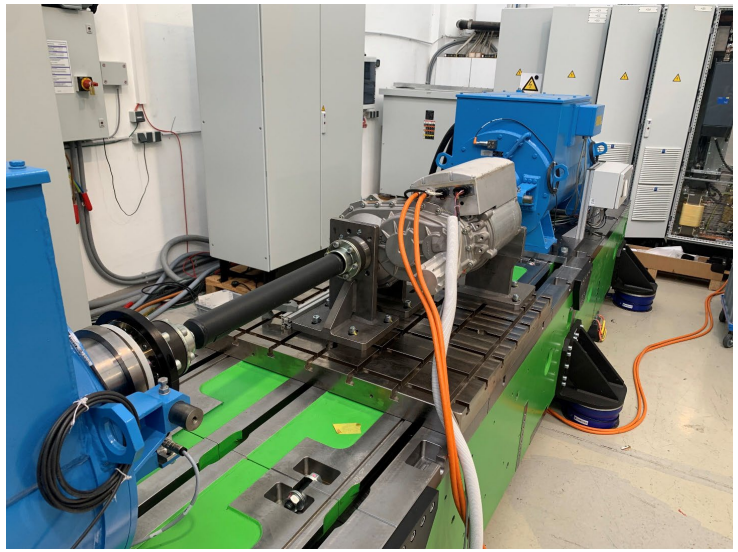
Powertrain Test Rig

- Testing of electric powertrain units for electric vehicles
- Real-time capability
- Highly modular overall design

Output Motor (x2)		
Power	P_{nom}	250 kW
Speed	n_{nom}	680 rpm
	n_{max}	2 000 rpm
Torque	M_{nom}	3 500 Nm
	M_{max}	11 500 Nm

DC-Source/Sink for Battery Simulation		
Power	P_{nom}	250 kW
Voltage	U_{nom}	730 V
Current	I_{nom}	± 600 A



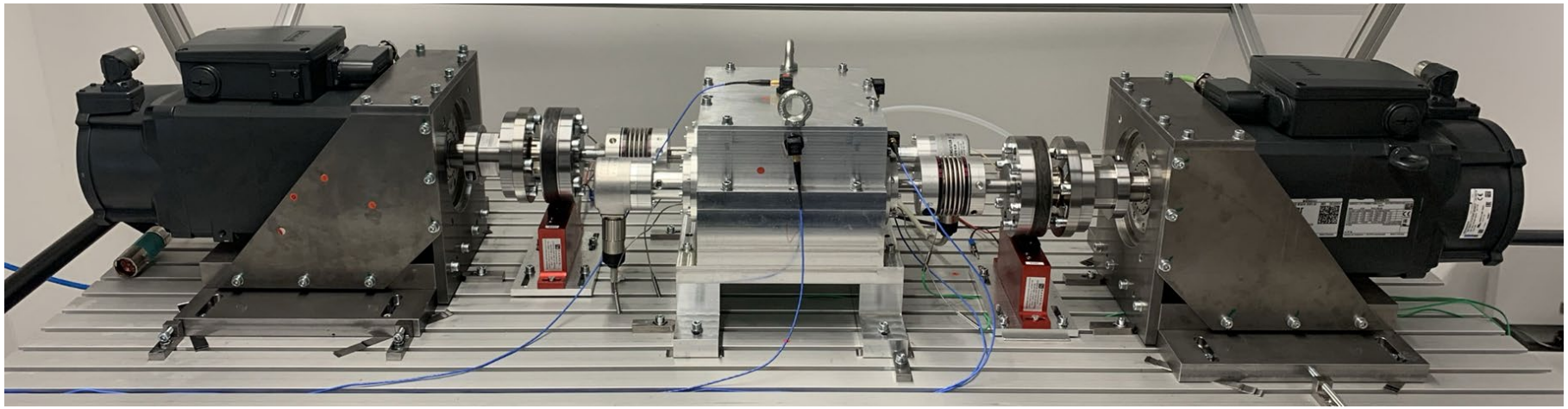


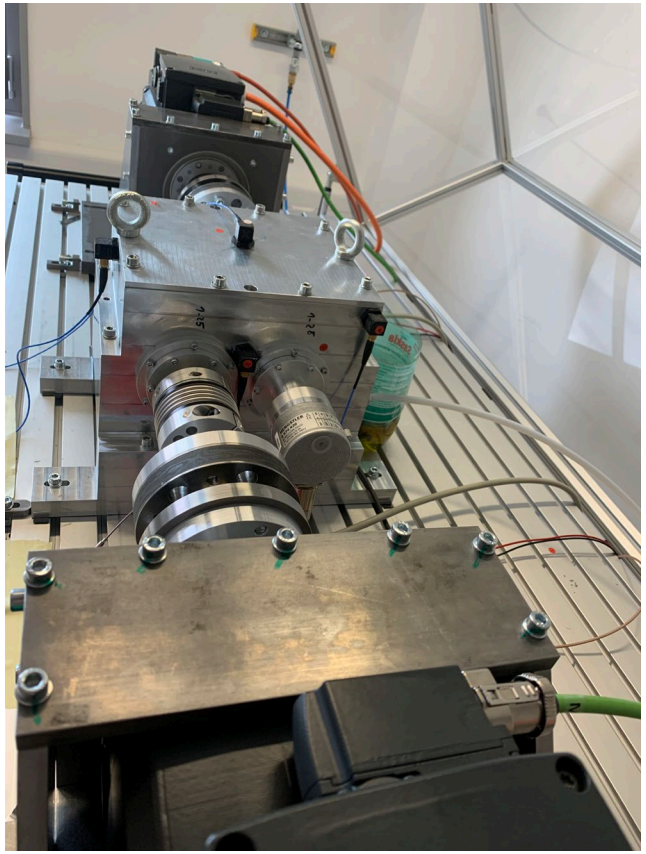
Lab Equipment

Gear Test Rig

- Optimizing the efficiency and noise emissions of gears
- Real-time capability
- High-precision testing of gears

Motor (2x)		
Power	P_{nom}	5,5 kW
	P_{max}	23,5 kW
Speed	n_{nom}	5 500 rpm
	n_{max}	20 000 rpm
Torque	M_{nom}	10 Nm
	M_{max}	45 Nm





What we can offer

- Test Rig **Operations** and Test Rig **Development** Expertise
- The test rigs are modular and can be **adapted to battery and hydrogen technologies**
- **Simulation Expertise** in complex mechanical/dynamic systems
- **Product Development Process** and **Methodology** Expertise

Opportunities for Collaboration

Battery testing - Calls of interest

HORIZON-CL5-2025-04-D5-04: Extended lifetime of road Battery Electric Vehicles (BEV) (2ZERO Partnership)

HORIZON-CL5-2026-01-D2-01: Development of sustainable and design-to-cost batteries with (energy) efficient manufacturing processes and based on advanced and safer materials (Batt4EU Partnership)

HORIZON-CL5-2026-01-D2-05: Accelerated multi-physical and virtual testing for battery aging, reliability, and safety evaluation (Batt4EU Partnership)

HORIZON-CL5-2025-02-D2-06: Fostering the European battery ecosystem by providing accurate and up-to-date information and stimulating excellence in the European battery R&I community (Batt4EU Partnership)

Selected Publications

- Jäger, S., Schätzle, J. u. Linde, T.: Top-Down Validation Framework for Efficient and Low Noise Electric-Driven Vehicles with Multi-Speed Gearbox. World Electric Vehicle Journal 13 (2022) 12, S. 228
- Jäger, S., Linde, T. u. Schulz, K. von: Product Development Methodology Targeting Efficiency and Acoustics of E-Mobility Gearboxes. In: Jungk, M. (Hrsg.): TuS - Tribologie und Schmierungstechnik, Volume 71. 2024, S. 33–41
- Schulz, K. von; Linde, T.; Jäger, S. External Damping of Roller Bearings and Its Effect on the Acoustics of an E-Mobility Gearbox. SAE Technical Paper 2025, in press (peer-review completed, paper accepted)
- Schulz, K. von, Linde, T. u. Jäger, S.: Profile Modifications for Gears and their Effect on the NVH Behaviour of an Electric Vehicle Gearbox. 2024 Stuttgart International Symposium on Automotive and Engine Technology. Stuttgart 2024
- Schulz, K. von; Linde, T.; Jäger, S. Measures to reduce the noise emission of a gearbox for electric vehicles. In Tagungsband Tribologie-Fachtagung 2024. 65. Tribologie-Fachtagung 2024, Göttingen, 23.-25.09.2024; GfT - Gesellschaft für Tribologie, Ed., 2024; pp 394–403
- Jäger, S.; Linde, T.; Wenzel, S. Lightweight gearbox housing by topology optimization and additive manufacturing for electric vehicles. In Proceedings of 15th International Expert Forum: Conference on electric vehicle drives and e-mobility. Conference on electric vehicle drives and e-mobility, Schweinfurt, 27.-28.09.2023; FVA - Forschungsvereinigung Antriebstechnik e.V., Ed., 2023; pp 77–83.