



Cottbus UTC – Multidisciplinary Process Integration

Klaus Höschler, Bernd Beirow

<https://www.b-tu.de/rolls-royce-utc/>

UTC Overview 2022

UK & worldwide (20 w/o Germany)

University of Birmingham: [Materials](#)

University of Bristol: [Composites](#)

Cambridge University: [Materials](#) / [University Gas Turbine Partnership](#)

University of Cranfield: [Performance](#)

Imperial College London: [Vibration](#) / [Nuclear engineering](#)

Loughborough University: [Combustion System Aerothermal Processes](#)

University of Manchester: [Power Conversion Systems](#)

University of Nottingham: [Gas Turbine Transmission Systems](#) / [Manufacturing Technology](#)

University of Oxford: [Heat Transfer & Aerodynamics](#) / [Solid Mechanics](#)

University of Sheffield: [Advanced Electrical Machines](#) / [Controls & Systems Engineering](#)

University of Southampton: [Computational Engineering](#) / [Noise](#)

Strathclyde University at Glasgow: [Electrical Power Systems](#)

University of Surrey at Guildford: [Thermo-fluid Systems](#)

Swansea University: [Materials](#)

University of Genoa (Italy): [Fuel Cell Systems](#)

Nanyang Technology University (Singapore): [Rolls-Royce@NTU Corporate Lab](#)

Purdue University (USA): [High Mach Propulsion](#)

Pusan (South Korea): [Thermal Management](#)

University of Virginia (USA): [Advanced Material Systems](#)

Virginia Tech (USA): [Advanced Systems Diagnostics](#)



Further: 5 Research Centers

Germany (4)

BTU Cottbus - Senftenberg: [Multidisciplinary Process Integration](#)

TU Darmstadt: [Combustion & Turbine Aerothermal Interactions](#)

TU Dresden: [Lightweight Structures & Materials](#)

KIT Karlsruhe: [Cooling & Secondary Flows](#)

Research Centers

DLR (Berlin): [Combustion, Noise & Aerothermal Methods](#)

Fraunhofer RWTH Aachen: [Rotatives repair](#)

Cooperations of Cottbus UTC with other:

[Dresden / Darmstadt / Karlsruhe / Imperial College](#)

- Joint research projects
- Joint master theses and staff transfer

Particularity of Cottbus UTC

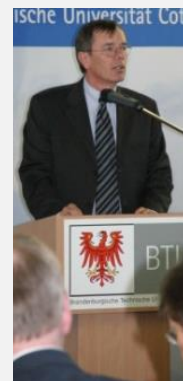
[Not focused on 1 or 2 subjects, widely spread research](#)



- **2001:** Beginning of joint research RR-BTU
- **2002:** Cooperation agreement signed
- **2003:** Establishment of the unique study course 'Aero Engine Technology' in Germany (DLR, MTU, RRD)
- **2005:** Grand opening of UTC as first UTC in Germany (11 April 2005, first UTC Director: Arnold Kühhorn)

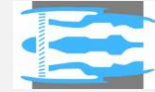
Focus on **Multidisciplinary Process Integration**

- **2007:** Honorary professorship 'Jet engine thermodynamics' to Roland Fiola, RRD
- **2016:** Honorary doctorate to Uli Wenger, RRD
- **2016:** 10 years UTC anniversary celebration (16 November 2016)
- **since 2019:** UTC director **Klaus Höschler**
- **2020 and 2022:** Host of Rolls-Rolls Research Partners Seminar (2020: in celebration of 15 years UTC anniversary celebration)



Aero Engine Design (FTD), K. Höschler

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Structural Mechanics and Vehicle Vibrations (SMF)

B. Beirow (interim)

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Engineering Mechanics and Vehicle Dynamics (TMF)

D. Bestle

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Automation Technology (AT), U. Berger

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Media Technology (MT), C. Hentschel

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Database and Information Systems (DBIS), I. Schmitt

schmitt@b-tu.de



Power Electronics and Propulsion Systems (LEA).

G. Möhlenkamp

Georg.Moehlenkamp@b-tu.de

Metallurgy and Materials Technology (MWT), S. Weiß

sabine.weiss@b-tu.de

Control Systems and Network Control Technology (RuN)

J. Schiffer

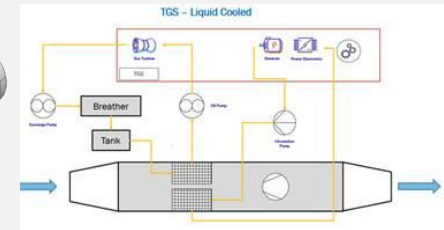
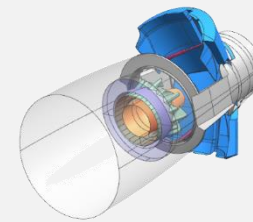
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Hybrid Manufacturing (FHF), S. Härtel

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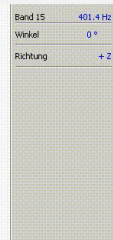
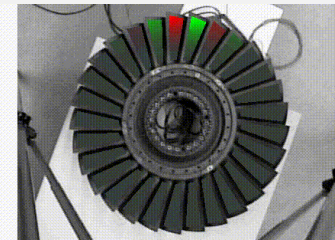
Aero Engine Design (Höschler)

- Automation of construction and analysis methods, concept studies
- Mechanical concepts for aero engine installation and integration
- Multi-functional system integration, incl. system safety analyses
- Thermal management of hybrid-electric propulsion systems



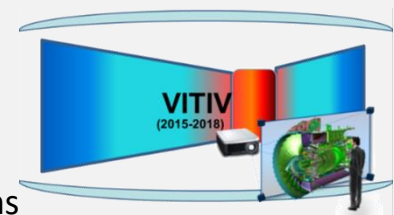
Structural Mechanics and Vehicle Vibrations (Beirow, interim)

- Aeroelastics, blade and blisk vibration
- Mistuning: measurement, modelling and simulation
- Structural and topology optimisation, WEM and component modelling



Engineering Mechanics and Vehicle Dynamics (Bestle)

- Artificial Intelligence (AI)-aided multidisciplinary multicriteria optimisation considering mechanical, structural dynamic, and aerodynamic aspects
- Robust design of aero engines
- Modelling, parameter identification, and virtual prototyping of mechatronic systems
- Linear and non-linear vibration



Automation Technology (Berger)

- AI-based assistance systems for aero engine assembling and quality management
- Human-robot collaboration in aviation industry
- AR and VR based learning and training methods
- Multimodal machine networking for real time data processing.



Media Technology (Hentschel)

- Virtual and augmented reality systems
- Classic and AI-based image processing
- Visualisation of large geometries and transient simulation in VR
- VR-AR collaboration
- Multi-sensor data fusion and processing

Database and Information Systems (Schmitt)

- Knowledge representation and modelling
- Data analysis and pattern recognition,
- Quantum logic

Power Electronics and Propulsion Systems (Möhlenkamp)

- Hybrid electric propulsion systems

Control Systems and Network Control Technology (Schiffer)

- Modelling, controlling and monitoring of complex technical systems
- Power and energy management of electric systems
- Robust control strategies for electric propulsion.



Rolls-Royce Hybrid-Electric Flight Demonstrator
(Source: rolls-royce.com)

Metallurgy and Materials Technology (Weiß)

- Metal-ceramics based wear-, corrosion- and high temperature-protection
- Protective coatings against erosion, erosion testing
- Micro structure characterisation and design, damage analysis

Hybrid Manufacturing (Härtel)

- Development of additive and forming manufacturing processes for the production of aerospace components
- Digitalization, simulation and optimization of process chains
- Combination of additive manufacturing of forming technology to improve component properties



- PhDs: 5
- Recruitment at RR: 2
- 11 papers
- 5 master/bachelor thesis with RR themes
- 19 projects in process
- RR project team members: 39
- Projects with RR total sum: 5,3 M€

Rey Villazon, J. M., Berthold, M., Kühhorn, A.

Adaptive Flow Field Thermal Modeling Techniques for Turbine Rotor-Stator Cavities

Paper GT2013-94845, Proceedings of ASME Turbo Expo 2013, June 3-7, San Antonio, Texas, USA

Rolls-Royce Innovation Award 2013

Figaschewsky, F., Kühhorn, A.

Analysis of Mistuned Blade Vibrations Based on Normally Distributed Blade Individual Natural Frequencies

Proceedings of ASME Turbo Expo 2015, GT2015-43121, 13-19 June 2015, Montréal, Canada

Rolls-Royce Innovation Award 2015

Figaschewsky, F., Kühhorn, A., F., Beirow, B., Giersch, T., Schrape, S.

Experimental Analysis of Mistuned Forced Response in an Axial High Pressure Compressor Rig With Focus on Tyler-Sofrin Modes,

Proceedings of ISABE 2017, ISABE-2017-22614, Manchester, 2017.

Rolls-Royce Innovation Award 2017

Kober, M., Kühhorn, A.

Stable implicit time-integration of flexible rotating structures - explanation for instabilities and concepts for avoidance. *Applied Mathematical Modelling, Volume 60, August 2018, Pages 235-243.*

Rolls-Royce Innovation Award 2018 (1st place)

Figaschewsky, F., Hanschke, B., Kühhorn, A.

Efficient Generation of Engine Representative Tip Timing Data Based on a Reduced Order Model for Bladed Rotors. *Proceedings of ASME Turbo Expo 2018, GT2018-76342, June 11-15, 2018, Lillestrom (Oslo), Norway.*

Rolls-Royce Innovation Award 2018 (2nd place)

Figaschewsky, F., Kühhorn, A., Beirow, B., Giersch, T., Schrape, S., Nipkau, J.

An inverse approach to identify tuned aerodynamic damping, system frequencies and mistuning – Part 3: Application to engine data.

Proceedings of ASME Turbo Expo 2019, GT2019-91337, June 15-21, 2019, Phoenix, AZ, USA.

Rolls-Royce Innovation Award 2019