

VDI

Europe invites the world

September 15 - 17, 2021

# International Conference on Gears 2021

FZG, Garching/Munich, Germany

#vdi\_gears

Source: Getriebbau NORD GmbH & Co. KG

## Key topics:

- Improved simulation methods
- Lubrication for enhanced efficiency
- Condition monitoring with smart gear system
- Multi-body simulation and NVH prediction
- Improved calculation methods for strength and efficiency



## Gears interactive

- GearArena
- Speakers meet up
- FZG lab tours
- Poster exhibition
- Two gear community nights

## Associated organisations:



American Gear Manufacturers, USA



ARTEMA, France



ASSIOT, Italy



BAPT



British Gear Association



Chinese Mechanical Engineering Society



Canadian Society for Mechanical Engineering



CSVTS, Czechia



Drive Technology Research Association, Germany



Gear Research Institute, USA



Scientific Society of Mechanical Engineers, Hungary



IFTOMM



Institution of Mechanical Engineers, United Kingdom



Japan Society of Mechanical Engineers



The Korean Society of Mechanical Engineers, Korea



SICE, Japan



Romanian Association of Mechanical Transmissions



Technical Chamber of Greece



WiGeP, Germany

## Visit parallel conferences free of charge



Gear Production 2021

[www.vdiconference.com/02TA411021](http://www.vdiconference.com/02TA411021)



High Performance Plastic Gears 2021

[www.vdiconference.com/02TA409021](http://www.vdiconference.com/02TA409021)



An event organized by VDI Wissensforum

[www.vdi-gears.eu](http://www.vdi-gears.eu)

### 1st Conference day

Wednesday, September 15<sup>th</sup>, 2021

08:15 Registration

#### Plenary lectures

09:45 Joint welcome and opening of

- International Conference on Gears 2021
- International Conference on High Performance Plastic Gears 2021
- International Conference on Gear Production 2021

**Prof. Dr.-Ing. Karsten Stahl**, FZG, Technical University of Munich (TUM), Garching, Germany

10:05 Welcome address by

**Dr.-Ing. Burkhard Pinnekamp**, Head of Central Technology, Renk GmbH, Augsburg; President, Research Association for Drive Technology (FVA), Frankfurt, Germany

10:15 Keynote session: Innovation flashlights: What will be the next game-changing innovations and technologies?

**Demands in gear technology in structural change in the economy**

**Prof. h. c. Dr.-Ing. Aizoh Kubo**, General Manager, Research Institute for Applied Sciences, Kyoto, Japan

**The innovator's DNA**

**Sonja Goris, M. Sc. Mech Eng.**, IP & Innovation Manager, ZF Wind Power Antwerpen NV, Antwerpen-Berchem, Belgium

**New ways to lubricate**

**Dr. Lutz Lindemann**, Member of the Executive Board (CTO), FUCHS PETROLUB SE, Mannheim, Germany

**High performance plastic gears in future applications**

**Prof. Dr.-Ing. Karl Kuhmann**, Head of Polymer Technology Development, High Performance Polymers, Evonik Operations GmbH, Marl, Germany

**Roller pairings with lubricant-impregnated sintered material**

**Prof. i. R. Dr.-Ing. Bernd-Robert Höhn**, TUM emeritus of excellence, Gear Research Centre (FZG), Technical University of Munich (TUM), Garching, Germany

With digital polls during the speeches

12:00 Time for working lunch – meet & greet in the exhibition area, poster presentation area and GearArena

#### Parallel sessions

##### International Conference on Gears

##### Parallel conferences – free of charge –

**International Conference on Plastic Gears**

[www.vdiconference.com/02TA409021](http://www.vdiconference.com/02TA409021)

**International Conference on Gear Production**

[www.vdiconference.com/02TA411021](http://www.vdiconference.com/02TA411021)

Lecture Room A

Lecture Room B

Lecture Room C

Lecture Room D

Lecture Room E

13:30 Determining tooth root strength

NVH

EHL contact

Applications

Manufacturing of internal gears

15:00 Coffee break – meet & greet in the exhibition area, poster presentation area and GearArena

16:00 Loaded tooth contact analysis

Non-involute and asymmetric gears

Condition monitoring/smart gears

Material properties

Innovative manufacturing processes

18:00 Organized bus transfer to the evening reception

19:00 Evening reception at the Hofbräuhaus in Munich

**Dinner Speech: Prof. Dr. Dr. h. c. mult. Wolfgang A. Herrmann**, President Emeritus, Technical University of Munich (TUM), Garching & Chairman of the Founding Board, Deutsches Zentrum Mobilität der Zukunft (DZM), Munich, Germany

# Program overview

## International Conference on Gears and parallel conferences

### 2nd Conference day

Thursday, September 16<sup>th</sup>, 2021

	International Conference on Gears			International Conference on Plastic Gears	International Conference on Gear Production
	Lecture Room A	Lecture Room B	Lecture Room C	Lecture Room D	Lecture Room E
08:30	Gear strength	Wear	Bevel and Hypoid Gears	Gear strength testing	Gear soft machining
10:00	Coffee break – meet & greet in the exhibition area, poster presentation area and GearArena				
11:00	Planetary gear transmission		Enhanced testing methods	Standardization of strength calculation	New concepts for machine and manufacturing processes
	Coffee break – meet & greet in the exhibition area, poster presentation area and GearArena				
14:00	Gear dynamics	Operating data acquisition	FEM analysis	Geometrical effects	Advances in special gearings
15:30	Coffee break – meet & greet in the exhibition area, poster presentation area and GearArena				
16:30	Gear strength – flank properties	CFD – churning and windage losses	Quality assurance and measurement	Temperature effects	Modeling in gear production
18:00	<b>Evening reception at the conference venue</b> <b>Dinner Speech: Prof. Dr.-Ing. Sebastian Bauer</b> , President, German Federation of Industrial Research Associations "Otto von Guericke" e. V. (AIF), Cologne & Managing Director (Research and Development), BAUER Maschinen GmbH, Schrobenhausen, Germany				

### 3rd Conference day

Friday, September 17<sup>th</sup>, 2021

	International Conference on Gears			International Conference on Plastic Gears	International Conference on Gear Production
	Lecture Room A	Lecture Room B	Lecture Room C	Lecture Room D	Lecture Room E
08:30	Friction	Simulation and optimization	Worm and crossed helical gears	Lubrication	Measurement technology
10:00	Coffee break – meet & greet in the exhibition area, poster presentation area and GearArena				
11:00	Multiparameter optimization	Material and heat treatment	High speed gears	Tribological investigation	Gear hard machining
12:30	Closing remarks	Closing remarks	Closing remarks	Closing remarks	Closing remarks
12:45	<b>Awarding of the best presentation for junior engineers by Prof. Dr.-Ing. Karsten Stahl</b> , FZG, Technical University of Munich (TUM), Garching, Germany <b>Awarding of the best paper by Dr.-Ing. Franz Völkel</b> , Sr. Vice President R&D, Business Division Transmission Systems, Schaeffler Technologies AG & Co. KG, Herzogenaurach, Germany + Lunchtime snack				
14:15	End of the conferences				

# Gears 2021

Europe invites the world!



### Lecture Room A



#### Determining tooth root strength

**Moderation:** Dr.-Ing. Hartmut Faust, Schaeffler Automotive Buehl GmbH & Co. KG, Germany/ Prof. Prof. Bingkui Chen, Chongqing University, China

#### 13:30 Gear root bending strength: statistical treatment of single tooth bending fatigue tests results

- Statistical analysis of STBF (Single Tooth Bending Fatigue Test) data
- Gear SN-curve estimation via maximum likelihood estimation (MLE) and statistic of extremes

**Luca Bonaiti, M. Sc.**, Prof. Ing. Carlo Gorla, Associate Professor, Prof. Dr.-Ing. Francesco Rosa, Assistant Professor, Department of Mechanical Engineering, Politecnico di Milano, Italy

#### 14:00 Improved method for the determination of tooth root endurance strength


- Load increment procedure for the precise estimation of the load capacity of each test tooth
- Evaluation of the influencing geometry parameters for an accurate calculation of fatigue strength

**Ahmad Alnahlai, M. Sc.**, Research Assistant, Prof. Dr.-Ing. Peter Tenberge, Full Professor, Chair of Industrial and Automotive Drivetrains, Ruhr-University Bochum, Germany

#### 14:30 A comparison of gear tooth bending fatigue lives from single tooth bending and rotating gear tests

- Discussion of statistical regression techniques for single tooth bending and rotating gear tests
- Translation factors for converting single tooth bending data to rotating gear data are introduced

**Isaac Hong, Ph. D.**, Research Scientist, Zach Teaford, Graduate Research Associate, Prof. Ahmet Kahraman, Howard D. Winbigler, Professor and Director, Gear and Power Transmission Research Laboratory, Department of Mechanical and Aerospace Engineering, The Ohio State University, Columbus, USA

 **15:00 Coffee break** – meet & greet in the exhibition area, poster presentation area and GearArena

**15:30 - 15:50** Poster presentations in the poster exhibition area

### Lecture Room B



#### NVH

**Moderation:** Prof. Dr.-Ing. Berthold Schlecht, Technical University of Dresden, Germany/ Dr.-Ing. Aleksandar Miltenović, University of Niš, Serbia

#### NVH calculations for drivetrains – how to select the best suitable calculation method for a specific purpose

- Calculation process for NVH using transmission design- and MBS-Software
- Effect of the low-contact-ratio (LCR) and high-contact-ratio (HCR) gear designs on gear loads and NVH

**Dipl.-Ing. Jürg Langhart**, Senior Engineer - Global Sales, Prof. Dr.-Ing. Saeed Ebrahimi, Software Developer, KISSsoft AG, Bubikon, Switzerland; Dr.-Eng. Davide Marano, Senior Transmission Engineer, Gearlab srl, Modena, Italy

#### Gear mesh excitation and non-uniform rational B-splines

- Tooth contour derived by shaping simulation
- Numerical modeling with isogeometric analysis

**Andreas Beinzingel, M. Sc.**, Chair of Vibroacoustics of Vehicles and Machines, Technical University of Munich (TUM), Garching & Computational Engineer, Renk GmbH, Augsburg; Dr.-Ing. Michael Heider, Head of Calculation Department, Renk GmbH; Prof. Dr.-Ing. Steffen Marburg, Chair of Vibroacoustics of Vehicles and Machines, TUM, Garching, Germany

#### NVH-performance vs. costs – coherent R&D for gears, system and manufacturing

- Interaction between NVH-performance of transmissions, gear quality/ -costs, technology and process in gear manufacturing
- Big data analysis

**Dipl.-Ing. Andreas Hessler**, Development Engineer, Transmission Gears, Dr.-Ing. Benedikt Neubauer, Director Gears, Business Division E-Mobility, Schaeffler Technologies AG & Co. KG, Herzogenaurach, Germany

### Lecture Room C



#### EHL contact

**Moderation:** Prof. Dr.-Ing. Bernd Sauer, Technische Universität Kaiserslautern, Germany/ Dr.-Ing. Toni Weiss, Gear Consultant, ret. from Renk GmbH, Augsburg, now GanaCon – Gear analysis and Consulting, Germany

#### Effectiveness of Roelands formula with constant viscosity-pressure coefficient (VPC) in the EHL solution of higher pair contact

- Effect of the different constant VPC on EHL results
- Comparisons between constant VPC and variable VPC

**Jiajia Zhang, Ph. D.**, Yumei Hu, Professor, Huan Zhang, Master, State Key Laboratory of Mechanical Transmission, Chongqing University, Chongqing City, China

#### Local pitting fatigue concept with EHL simulation for case hardened gears

- Consideration of surface roughness and sliding motion
- Analysis of stress history at different gear flank positions

**Aleksandar Eric, M. Sc.**, Component Design, Reliability and Validation Metals, Corporate Research, Robert Bosch GmbH, Renningen; Prof. Dr.-Ing. habil. Volker Schulze, Director of Manufacturing and Materials Technology, wbk Institute of Production Science, Karlsruhe Institute of Technology (KIT), Germany

#### 2x2-disc tribometer for various tests on sliding/rolling contacts with tribological loads such as in tooth flank contacts

- Simple test machine for micro-pitting and pitting tests with the same paths of local tribological stress as on the tooth flanks
- Tribometer which allows to analyze the stepwise progress of wear and fatigue without destroying the specimens

**Prof. Dr.-Ing. Peter Tenberge**, Full Professor, Chair of Industrial and Automotive Drivetrains, Ruhr-University Bochum, Germany



## Lecture Room A



### Loaded tooth contact analysis

**Moderation: Prof. Dr.-Ing. Christian Brecher**, RWTH Aachen University, Germany/**Dr.-Ing. Reiner Vonderschmidt**, Georgii Kobold GmbH & Co. KG, Germany

#### 16:00 Design, strength calculation by ISO10300 and loaded tooth contact analysis (TCA) of forged differential bevel gears

- Full design of forged differential gear sets
  - Loaded tooth contact analysis of forged differential gear sets
- Dr.-Ing. Joachim Thomas**, Managing Director, ZG Hypoid GmbH, Aschheim, Dipl.-Ing. Frederik Mieth, Research Assistant, Institute of Machine Elements and Machine Design, Faculty of Mechanical Science and Engineering, Technical University of Dresden, Germany; Claude Gosselin, P. Eng., Ph. D., Managing Director/CEO, Involute Simulation Softwares Inc., Quebec, Canada

#### 16:30 Innovative tooth contact analysis with non-uniform rational b-spline (NURBS) surfaces

- Comparison of NURBS and Bézier approach in tooth contact analysis (TCA)
  - Potential of flank and root description regarding stress and lifetime prediction
- Dipl.-Ing. Felix Müller**, Research Assistant, Dr.-Ing. Stefan Schumann, Chief Engineer, Prof. Dr.-Ing. Berthold Schlecht, Full Professor, Institute of Machine Elements and Machine Design, Faculty of Mechanical Science and Engineering, Technical University of Dresden, Germany

#### 17:00 Helical gear tooth micro-geometry optimization and its impact on gear durability and NVH

- Reduction of contact stresses, transmission error and mesh misalignment analysis
  - Purpose suitable micro geometrical modification to gear tooth profile
- Muhammad Asad Ur Rehman Bajwa**, Ph. D. Mech Eng., Researcher, Mechanical Engineering, Tianjin University, China

#### 17:30 End of the first conference day

#### 18:00 Organized bus transfer to the evening reception

#### 19:00 Evening reception at the Hofbräuhaus in Munich

You can look forward to a special evening event. Enhance your personal network and use the informal atmosphere for deeper-going discussions.



### Dinner speech

**Prof. Dr. Dr. h. c. mult. Wolfgang A. Herrmann**, President Emeritus, Technical University of Munich (TUM), Garching & Chairman of the Founding Board, Deutsches Zentrum Mobilität der Zukunft (DZM), Munich, Germany

## Lecture Room B



### Non-involute and asymmetric gears

**Moderation: Prof. Dr.-Ing. Manfred Hirt**, Past President, Research Association for Drive Technology (FVA), former board of Renk GmbH, Germany/**Dr. Alex Kapelevich**, AKGears, LLC, USA

#### Experimental validation of an analytical calculation method for determining the tooth root bending strength of asymmetric gears

- Systematic experimental investigations on the tooth root bending strength of asymmetric gears
  - Validation of an analytical calculation method for standardization
- Christian Weber, M. Sc.**, Mechanical Engineer, WEBER GMBH & Co. KG, Bodman, Dr.-Ing. Thomas Tobie, Head of Department, Department Load-Capacity Cylindrical Gears, Prof. Dr.-Ing. Karsten Stahl, Full Professor, Institute of Machine Elements, Director, Gear Research Centre (FZG), Technical University of Munich (TUM), Garching, Germany

#### Practical application of asymmetric tooth root geometry for downsizing automotive transmission gears

- Development of a hob design method for asymmetric tooth tip geometry
  - Validation of the effect on improving the tooth root strength for CVT gears
- Kunihiko Fukunoki**, Development Engineer, Hardware System Development Department, Jatco Ltd., Atsugi City, Dr.-Ing. Yoshitomo Suzuki, Engineering Management Department, Koji Matsuo, Development Engineer, Hardware System Development Department, Fuji Chity, Jatco Ltd., Japan

#### Contact characteristic of cycloid planetary gear drives considering relevant backlashes and clearances

- Analysis for cycloid gear drives with bearing clearances
  - Influences of the clearances on contact characteristics
- Ling-Chiao Chang, M. Sc.**, Dr.-Ing. Shyi-Jeng Tsai, Associate Professor, Department of Mechanical Engineering, National Central University, Taoyuan City, Taiwan, Ching-Hao Huang, Ph. D., Transmission Machinery Co., Ltd., Tainan City, Taiwan

## Lecture Room C



### Condition monitoring/smart gears

**Moderation: Prof. Dr.-Ing. Dr. h. c. Albert Albers**, Karlsruhe Institute of Technology (KIT), Germany/**Prof. Dr. Datong Qin**, Chongqing University, China

#### Sensor-integrated gears: wear detection by in-situ MEMS acceleration sensors

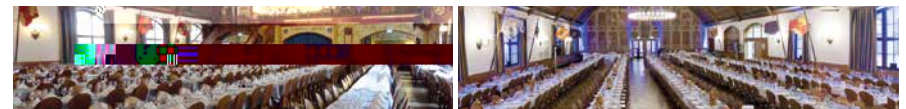
- Integration of MEMS acceleration sensors directly on gear
  - Optimization of wear detection by machine-learned regression
- Julian Peters, M. Sc.**, Research Assistant, Dr.-Ing. Thomas Gwosch, Head of Research Department Mechatronic Machine Elements and System Reliability, Univ.-Prof. Dr.-Ing. Sven Matthiesen, Chair of Power-Tools and Machine Elements at IPEK – Institute of Product Engineering, Karlsruhe Institute of Technology (KIT), Germany

#### Application of genetic algorithms for parameter identification in a developing smart gear system

- Parameter identification for the smart gear system
  - Optimizing error of parameter identification by genetic algorithms
- Thanh-Tung Mac, M. Sc.**, Faculty of Mechanical Engineering, Kyoto Institute of Technology, Kyoto, Japan

#### Feasibility study of measuring instantaneous angular speed of spur gears with magnetoresistive (MR) sensors

- Evaluation of measuring positions for condition monitoring of spur gears
  - Comparison of instantaneous angular speed (IAS) with accelerometer measurements
- Yanik Koch, M. Sc.**, Research Assistant, Prof. Dr.-Ing. Eckhard Kirchner, Director, Institute of Product Development and Machine Elements, Technische Universität Darmstadt; Dr.-Ing. Rolf Slatter, CEO, Sensitec GmbH, Wetzlar, Germany



*"Mobility is not only an essential feature of freedom – without it, living nature is unimaginable. The key to mobility of humankind and its communities has always been innovation, shaped by our engineers, coming full circle back to living freedom."*

**2nd Conference day**  
Thursday, September 16<sup>th</sup>, 2021

**Lecture Room A**



**Gear strength**

**Moderation: Dr.-Ing. Ralf Hess**, Flender GmbH, Germany/  
**Robin Olson, M. Sc.**, Rexnord Industries, LLC, USA

**08:30 Calculation approach to determine the risk of premature failures on gear drives components due to subsurface initiated cracks by contact stresses**

- Knowledge and experiences-based calculation method for the premature failure modes Tooth Flank Fracture (TFF) and White Etching Cracks (WEC)
- Calculation method in detail on TFF and WEC and summary of experiences explained by examples

**Dipl.-Ing. Dirk-Olaf Leimann**, Development Engineer, Moers, Germany

**09:00 Advanced use of DOE in gear macro-geometry optimization**

- Optimization of NVH-behavior, gear durability and efficiency
  - Quality and robustness improvement for gear performance
- Nikolaus Hessinger**, Simulation Engineer Transmission, Michael Braunstingl, B. Sc., Simulation Engineer Transmission, Hemant Bansal, M. Eng., Lead Engineer Transmission Simulation, Passenger Car Transmission Simulation and Testing, AVL List GmbH, Graz, Austria

**09:30 Influence of light grinding notches on the tooth root bending strength of case carburized cylindrical gears**

- Experimental investigations and grinding notch measurement analysis
  - Gears of different sizes and shot blasting treatments
- Karl Jakob Winkler, M. Sc.**, Research Associate, Teamleader manufacturing and lubrication, Dr.-Ing. Thomas Tobie, Head of Department, Department Load-Capacity Cylindrical Gears, Prof. Dr.-Ing. Karsten Stahl, Full Professor, Institute of Machine Elements, Director, Gear Research Centre (FZG), Technical University of Munich (TUM), Garching, Germany

**10:00 Coffee break** – meet & greet in the exhibition area, poster presentation area and GearArena

**10:30 - 10:50 Poster presentations in the poster exhibition area**

**Lecture Room B**



**Wear**

**Moderation: Prof. Dr.-Ing. Peter Tenberge**, Ruhr-University, Germany/  
**Prof. Ing. Carlo Gorla**, Politecnico di Milano, Italy

**Analysis of the mechanisms of action within the dry lubricated rolling-sliding contact of coated surfaces**

- Characterization of the friction behavior
  - Local wear analysis of the coating
- Sebastian Sklenak, M. Eng.**, Research Assistant, Dr.-Ing. Jens Brimmers, M. Sc., Chief Engineer, Gear Department, Prof. Dr.-Ing. Christian Brecher, Full Professor, Chair of Machine Tools, Laboratory for Machine Tools and Production Engineering, Faculty for Mechanical Engineering, RWTH Aachen University, Germany

**Improving pitting durability by introducing the non-linear wear propagation property of helical gears**

- Mechanism of pitting durability deviations at high loads
  - Influence of tooth-edge modifications on wear
- Dr.-Ing. Koji Kumagai**, Development Engineer, Powertrain Production Engineering and Development Division, Nissan Motor Co., Ltd., Kanagawa, Japan

**Wear simulation of worm gears based on an energetic model**

- Transient simulation of friction and wear of worm gears
  - Experimental determination of wear model parameters
- Dipl.-Ing. Kevin Daubach**, Research Assistant, Jun. Prof. Dr.-Ing. Manuel Oehler, Junior Professor for Mechanical Drive Technology, Prof. Dr.-Ing. Bernd Sauer, Full Professor, Head of MEGT – Institute of Machine Elements, Gears and Transmission, Department of Mechanical and Process Engineering, Technische Universität Kaiserslautern, Germany

**Lecture Room C**



**Bevel and hypoid gears**

**Moderation: Prof. Dr.-Ing. Michael Weigand**, TU Wien, Austria/  
**Prof. Dr. Eng. Ichiro Moriwaki**, Kyoto Institute of Technology, Japan

**Development of IP-bevel gears for industrial operation**

- Gear features in design and manufacturing
  - Performance in transmission error and in load carrying capability
- Prof. h. c. Dr.-Ing. Aizoh Kubo**, General Manager, Research Institute for Applied Sciences, Kyoto, Japan; Dr.-Ing. Akio Ueda, President, AMTEC Inc, Osaka, Japan; Dipl.-Ing. Hiroya Ishiyama, Product Engineer, DMG/MORI Co. Ltd., Iga, Japan

**Enhanced loaded tooth contact analysis of hypoid gears within a multi-body-system simulation**

- Enhanced load distribution calculation with reduced number of contact points
  - Stress analysis with speed improvements on hypoid gears
- Dipl.-Ing. Wolf Wagner**, Research Assistant, Dr.-Ing. Stefan Schumann, Chief Engineer, Prof. Dr.-Ing. Berthold Schlecht, Full Professor, Institute of Machine Elements and Machine Design, Faculty of Mechanical Science and Engineering, Technical University of Dresden, Germany

**Evolution mechanism and meshing performance of a series of novel worm drives with adjustable backlash**

- Local conjugation theory of novel worm drive based on meshing media
  - Meshing performance of novel worm drive during the evolution from line contact to point contact
- Xinxin Ye**, Academic Assistant, College of Mechanical and Vehicle Engineering, Chongqing University, China

## Lecture Room A



### Planetary gears

**Moderation:** Dipl.-Ing. Zsolt Roth, J. M. Voith SE & Co. KG | VTA, Germany/**Dr.-Ing. Kai Lubenow**, Eickhoff Antriebstechnik GmbH, Germany

#### 11:00 Dynamic load distribution of planetary gear sets subject to both internal and external excitations

- Dynamic response and contact stress distribution in planetary gears
- Influence of input torsional excitations

**Lokaditya Ryali**, Graduate Research Associate, Dr. David Talbot, Assistant Professor, Gear and Power Transmission Research Laboratory, Department of Mechanical and Aerospace Engineering, The Ohio State University, Columbus, USA

#### 11:30 Experimental investigation of the dynamic load sharing of planetary gearboxes

- High speed double-helical planetary gearbox
- Influence of load and speed on load sharing behavior

**Joshua Götz, M. Sc.**, Research Associate, Team Leader Gear Dynamics, Department Calculation and Verification of Gearbox Systems, Marius Fürst, M. Sc., Research Associate, Felix Siglmüller, M. Sc., Research Associate, Institute of Machine Elements, Gear Research Centre (FZG), Technical University of Munich (TUM), Garching, Germany

#### 12:00 Influences on the excitation behavior of lightweight planetary gearboxes

- Influences of misalignments and flexible ring gears on the transmission error
- Extension and validation of a tooth contact analysis

**Julian Theling, M. Sc.**, Team Leader Gear Acoustics, Gear Department, Dr.-Ing. Jens Brimmers, M. Sc., Chief Engineer, Gear Department, Prof. Dr.-Ing. Christian Brecher, Full Professor, Chair of Machine Tools, Laboratory for Machine Tools and Production Engineering, Faculty for Mechanical Engineering, RWTH Aachen University, Germany

#### 12:30 Time for a working lunch – meet & greet in the exhibition area, poster presentation area and GearArena

#### 13:00 - 13:20 Poster presentations in the poster exhibition area

## Lecture Room B



### Gear geometry optimization

**Moderation:** Prof. Dr.-Ing. Gerhard Poll, Leibniz University Germany/**Prof. Dr. Geng Liu**, Northwestern Polytechnical University & Shaanxi Engineering Laboratory for Transmissions and Controls, China

#### Parametric study of hypocycloidal involute gears

- Definition of the tip/tip interference condition in the internal gearing with a low tooth number difference
- Definition of the effective contact ratio of hypocycloidal involute gears under load.

**Dr.-Ing. Alex Kapelevich**, Consultant, Yuriy V. Shekhtman, Senior Researcher, AKGears, LLC, Shoreview, Minnesota, USA

#### Pitch error analysis on gear rolling-forming with radial-feeding

- Pitch error analysis of gear rolling-forming process with radial feeding
- Experiment validation of pitch error with two sets of tooth numbers

**Dr.-Ing Peng Bo**, Yuanxin Luo, Chengsheng Li, College of Mechanical and Vehicle Engineering, Chongqing University, China

#### Very fast tooth root optimization – general tool geometry for much smaller tooth root stresses

- Stepwise modification of the hobbing tool geometry and fast simulation of the hobbing process
- Using a new FEM calibrated analytic function for a fast optimization process to minimize the maximum tooth root stress

**Prof. Dr.-Ing. Peter Tenberge**, Full Professor, Chair of Industrial and Automotive Drivetrains, Ruhr-University Bochum, Germany

## Lecture Room C



### Enhanced testing methods

**Moderation:** Dr.-Ing. Carsten Gitt, Mercedes-Benz AG, Germany/**Prof. Dr.-Ing. José I. Pedrero**, Universidad Nacional de Educación a Distancia (UNED), Spain

#### Suitability of the test results of micropitting tests acc. to FVA 54/7 for modern practical gear applications

- Influence of the material of case-hardened gears on the test results
- Influence of geometry (use of flank modifications and helical gears) and grinding method (profile grinding) of test gears on the test result

**Nadine Sagraloff, M. Sc.**, Research Associate, Dr.-Ing. Thomas Tobie, Head of Department, Department Load-Capacity Cylindrical Gears, Prof. Dr.-Ing. Karsten Stahl, Full Professor, Institute of Machine Elements, Director, Gear Research Centre (FZG), Technical University of Munich (TUM), Garching, Germany

#### Test rig concept for high power very high cycle fatigue (VHCF) gear testing

- Concept for tooth root testing at high rotational speeds
- Challenges for high-speed gear testing under reversed bending

**Moritz Trippe, M. Sc.**, Research Assistant, Gear Department, Dr.-Ing. Jens Brimmers, M. Sc., Chief Engineer, Gear Department, Prof. Dr.-Ing. Christian Brecher, Full Professor, Chair of Machine Tools, Laboratory for Machine Tools and Production Engineering, Faculty for Mechanical Engineering, RWTH Aachen University, Germany

#### Mode III threshold under rolling contact fatigue (RCF) and development of a test gearbox for planet gears

- Determining mode III threshold under RCF for thin-rimmed gears
- Development of test rig for testing 3-gear train planet gears layout

**Prasad Mahendra Rao, M. Sc.**, Prof. Dr.-Ing. Stefano Foletti, Associate Professor, Prof. Ing. Carlo Gorla, Associate Professor, Department of Mechanical Engineering, Politecnico di Milano, Italy



## Lecture Room A



### Gear dynamics

**Moderation:** **Dr.-Ing. Heinz-Uwe Arnscheidt**, Volkswagen AG, Germany/**Prof. Dr.-Ing. Philippe Velex**, INSA – Institut National des Sciences Appliquées de Lyon, France

#### 14:00 An experimental study of parametric resonances of a spur gear pair at speeds above its primary resonance

- Experimental demonstrations of parametric resonances of a spur gear pair

• High-speed spur gear set-up and associated instrumentation  
**Prof. Ahmet Kahraman**, Professor and Director, Cihan A. Celikay, Graduate Research Associate, Ata Donmez, Graduate Research Associate, Gear and Power Transmission Research Laboratory, The Ohio State University, Columbus, Ohio, USA

#### 14:30 Application of gear profile dynamic modification on a three-axis integrated transmission system for vibration reduction

- Performance optimisation of manufacturing deviations
- Design, simulation and analysis of gears and transmissions

**Pu Gao, Ph. D.**, Research Assistant, Prof. Hui Liu, Professor, Vehicle Research Center, Beijing Institute of Technology, Prof. Dr. Changle Xiang, Vice-President, Beijing Institute of Technology, Director, National Key Lab of Vehicle Transmission, Beijing, China

#### 15:00 Influence of thin rimmed/-webbed gears on transmission dynamic behavior – approximate dynamic factor formula

- Dynamic factor formula for the 3D FE gear hybrid model
- Web/mesh dynamic coupling in a thin-rimmed/-webbed gear

**Dr.-Ing. Guilbert Bérengère**, Associate Prof., Prof. Dr.-Ing. Philippe Velex, Full Professor, LaMCoS, INSA – Institut National des Sciences Appliquées de Lyon, Villeurbanne Cédex, France



15:30 **Coffee break** – meet & greet in the exhibition area, poster presentation area and GearArena

16:00 - Poster presentations in the poster exhibition area  
16:20

## Lecture Room B



### Operating data acquisition

**Moderation:** **Dr.-Ing. Burkhard Pinnekamp**, Renk GmbH, Augsburg & Research Association for Drive Technology (FVA), Germany/**Prof. Prof. Dr.-Ing. Athanassios Mihailidis**, Aristotle University of Thessaloniki, Greece

#### Generation of torque spectrum from measured torque-speed-time data

- "Rainflow method" when torque has both positive and negative signs
  - Duty cycle acc. ISO6336-6 with added mean stress influence factor
- Dr.-Ing. Ulrich Kissling**, President, KISSsoft AG, Bubikon, Switzerland

#### Data mining in a fleet of train gearboxes using smart oil plug

- Use of pattern recognition and data analysis techniques to find faults in a number of train gearboxes in a fleet
- Extraction of information from frequency spectrum of acceleration signals recorded from the gearboxes whilst in operation

**Dr. Nathan Craig**, Data Analyst, Sam Ellwood, MMath., Data Analyst, Data Analysis, Transmission Dynamics, Newcastle upon Tyne, United Kingdom; Krzysiek Rosinski, M. Sc., Senior Software Engineer, Software Team, Transmission Dynamics Poland, Krakow, Poland

#### Experimental study of gear tooth crack detection in a high-loaded gearbox

- Dynamic strain gage and vibration measurements
- Method of modelling the influence of defects in gears on dynamic loads

**Dmitry Kalinin**, Head of "Strength, Life and Optimal design" department, Andrey Zemskov, Deputy Director "Aviation Drive Engineering Center", Central Institute of Aviation Motors (CIAM), Moscow, Russia

## Lecture Room C



### FEM analysis

**Moderation:** **Dipl.-Ing. Norbert Haefke**, Research Association for Drive Technology (FVA), Germany/**Prof. Wenzhong Wang**, Beijing Institute of Technology, China

#### Dynamic modeling and accuracy evaluation method for complex irregular components of aviation transmissions

- Multi-method interactive verification of irregular components modeling
  - Quantitative accuracy evaluation method of condensation model
- Dr. Aiqiang Zhang**, Research Assistant, Jing Wei, Ph. D./Professor, The State Key Laboratory of Mechanical Transmissions, Chongqing University, China

#### Stress calculation on bevel gears with FEM influence vectors

- Loaded tooth contact analysis with bevel gears
  - Subsurface stress state and load capacity of bevel gears
- Dipl.-Ing. Frederik Mieth**, Research Assistant, Dipl.-Ing. Carsten Ulrich, Research Assistant, Prof. Dr.-Ing. Berthold Schlecht, Full Professor, Institute of Machine Elements and Machine Design, Faculty of Mechanical Science and Engineering, Technical University of Dresden, Germany

#### Finite element tooth contact analysis of crossed helical gear drives considering misalignments and deviations

- Impact of deformation, misalignment and manufacturing deviations
- Tooth contact analysis

**Prof. Dr.-Ing. Athanassios Mihailidis**, Full Professor, Head of the School of Mechanical Engineering, Laboratory of Machine Elements and Machine Design, Aristotle University of Thessaloniki, Greece



## Gear strength – flank properties

**Moderation: Dr.-Ing. Jörg Börner**, ZF Friedrichshafen AG, Germany/  
**Prof. Haruo Houjoh**, Emeritus Professor, Tokyo Institute of Technology, Japan



## CFD – churning and windage losses

**Moderation: Dr.-Ing. Rolf Döbereiner**, AVL List GmbH, Austria/  
**Prof. Dr. Eng. Jože Duhovnik**, University of Ljubljana, Slovenia



## Quality assurance and measurement

**Moderation: Dr.-Ing. Jörg Hermes**, SEW-Eurodrive GmbH & Co. KG, Germany/  
**Eng. Amir Aboutaleb**, American Gear Manufacturers Association, USA

**16:30 Combining improved gear efficiency and improved fatigue performance through mass finishing**

- Friction modified by enhanced topography and microstructure
- Fatigue modified by introduced compressive stress

**Florian Reinle, M. Sc.**, Advanced Development Engineer, Advanced Development & Tribology, OTEC Präzisionsfinish GmbH, Straubenhardt, Germany; **Ing. Enrico Morgano**, Powertrain Materials Engineering Manager, Product Development, CRF Centro Ricerche Fiat S.C.p.A., Orbassano, Italy

**17:00 Influence of material roughness, hardness and lubricant additives on the micropitting behaviour of gears**

- Influence of material properties on the micropitting process
- Effect of lubricant additives for suppressing micropitting

**Takuya Ohno, B. Eng.**, Lubricants Researcher, Lubricants Research Laboratory, Idemitsu Kosan Co., Ltd., Ichihara-shi, Japan; **Dr.-Ing. René Greschert**, Testing Engineer, **Dr.-Ing. Jens Brimmers, M. Sc.**, Chief Engineer, Gear Department, Chair of Machine Tools, Laboratory for Machine Tools and Production Engineering (WZL), Faculty for Mechanical Engineering, RWTH Aachen University, Germany

**17:30 Increased load carrying capacity of gears through optimized steel performance, surface conditions and processes**

- Back-to-back testing of three steel performance levels
- Steel performance influence on high quality manufacturing

**Elias Löthman, M. Sc.**, Application Engineer, Industry Solutions Development, Ovako AB, Hofors, Sweden, **Dr.-Ing. Michael Hein**, Head of Department Worm gears and Bevel gears, Fatigue life analysis, Gear Research Centre (FZG), Technical University of Munich (TUM), Garching, Germany, **Urs Steiner, M. Eng.**, Team leader, Research and Testing, Humbel Zahnräder AG, Kradolf, Switzerland

**18:00 Evening reception at the university**

Enhance your personal network and use the relaxed and informal atmosphere for deeper-going conversations with other participants and speakers.



### Dinner speech

**Prof. Dr.-Ing. Sebastian Bauer, President**, German Federation of Industrial Research Associations "Otto von Guericke" e. V. (AiF), Cologne & Managing Director (Research and Development), BAUER Maschinen GmbH, Schrobenhausen, Germany

**Prediction of churning losses in an industrial gear box with spiral bevel gears using the smoothed particle hydrodynamic method**

- Oil distribution and churning losses with SPH simulations
- Churning loss distribution per component

**Dipl.-Ing. Benjamin Legrady**, Customer Success Engineer, Markus Taesch, M. Sc, Customer Success Engineer, dive solutions GmbH, Berlin, Germany; **Dipl.-Ing. Frederik Mieth**, Research Assistant, Institute of Machine Elements and Machine Design, Faculty of Mechanical Science and Engineering, Technical University of Dresden, Germany

**On windage power loss reduction achieved by flanges**

- Efficiency of high-speed gears
- Windage power loss – mitigation strategies using flanges

**Dr.-Ing. Michal Ruzek**, Assistant Professor, Prof. Fabrice Ville, Professor, LaMCoS, INSA – Institut National des Sciences Appliquées de Lyon, Villeurbanne Cedex, France, **Dr. Yann Marchesse**, Associate Professor, ECAM, Lyon, France

**CFD analysis on the oil flow of a gear stage with guide plate**

- Numerical modeling of gearbox oil flow and validation
- Influence of a guide plate on oil distribution and no-load power-loss

**Lucas Hildebrand, M. Sc.**, Research Assistant, Gear Research Centre, Technical University of Munich, **Dr.-Ing. Thomas Lohner**, Head of department EHL-Tribological Contact and Efficiency, **Prof. Dr.-Ing. Karsten Stahl**, Full Professor, Institute of Machine Elements, Director, Gear Research Centre (FZG), Technical University of Munich (TUM), Garching, Germany

**Optical determination of the mean base circle radius of large gears**

- Flexible measuring concepts for large gears
- Model-based scanning multi-distance inspection approach

**Dipl.-Ing. Axel von Freyberg**, Research Assistant, Marc Pillarz, M. Sc., Research Assistant, Prof. Dr.-Ing. habil. Andreas Fischer, Institute Director, Institute for Metrology, Automation and Quality Science, University of Bremen, Germany

**Effect of a multi-stage grinding process on the Barkhausen noise signal**

- Impact of roughing and finishing on Barkhausen noise
- Contribution to a reliable detection of grinding burn

**Tobias Hüsemann, M. Sc.**, Research Fellow, Abrasive Processes and Gear Technology, **Dr.-Ing. Daniel Sackmann**, former Research Fellow, Abrasive Processes and Gear Technology, **Prof. Dr.-Ing. habil. Prof. h. c. Dr. h. c. Dr. h. c. Bernhard Karpuschewski**, Director, Manufacturing Technologies, Leibniz Institute for Materials Engineering – IWT, Bremen, Germany

**Tooth profile error detection using only a small spot type of laser sensor**

- Tooth profile error tendency can be obtained from laser beam reflection
- This method is very simple, low cost, able to quickly do many times

**Prof. Dr. Eng. Eiichiro Tanaka**, Professor, Graduate School of Information, Production and Systems, Faculty of Science and Engineering, Waseda University, Kita-kyushu, **Prof. Dr. Eng. Masakazu Nakasako**, Professor, National Institute of Technology, Kure College, **Dr. Eng. Kiyotaka Ikejo**, Assistant Professor, Hiroshima University, Hiroshima, Japan



*"Despite all digitalization in the world, also in future real forces will have to be transmitted. Thus, developing and manufacturing transmission systems which aim at the best efficiency factor as well as the lowest possible lifetime costs will always be a challenge for all people involved."*

3rd Conference day  
Friday, September 17<sup>th</sup>, 2021

Lecture Room A



**Friction**

**Moderation:** Dr.-Ing. Andreas Klein, Flender GmbH – Winergy, Germany/Dr. Michel Octrue, former CETIM (Technical Center for Mechanical Engineering Industries), Senlis, France

08:30 **Minimum friction losses in wind turbine gearboxes**

- Optimal shift coefficients of wind turbine gearboxes for minimum friction losses
- Minimum friction losses, with regard to bending and pitting strength requirements

**Prof. Dr.-Ing. José I. Pedrero**, Full Professor, Dr.-Ing. Miguel Pleguezuelos, Associate Professor, Department of Mechanics, Faculty of Engineering, Universidad Nacional de Educación a Distancia (UNED), Madrid, Spain; Ing. José Calvo-Irizarri, Gearbox Section Manager, Gamesa Energy Transmission – SGR ON, Zamudio, Spain

09:00 **Holistic friction optimization of transmissions – a significant contribution to sustainability**

- Universal friction model for bearings and gears
  - Friction reduction in transmissions with an optimization algorithm
- Philipp Rödel, M. Sc.**, Senior Specialist – Engineering Methods, Dipl.-Ing. Roland Spieler, Expert - Engineering Methods & Tool Development, R&D Analysis Tools & Methods Development, Schaeffler Technologies AG & Co. KG, Schweinfurt; Dipl.-Technomat. Tobias Nuißl, Senior Specialist Engineering Methods & Tools Development, R&D Analysis Tools for Digital Services, Schaeffler Technologies AG & Co. KG, Herzogenaurach, Germany

09:30 **Coefficient of friction behavior of gear oils and significance for the meshing process of spur gears**

- Base oil and type of VI improver determine friction
  - Low friction leads to lower noise emissions of the gearbox
- Dr.-Ing. Axel Baumann**, Head of Application Support, Instrumentation and Test Systems, AVL Deutschland GmbH, Mainz-Kastel, Germany

10:00 **Coffee break** – meet & greet in the exhibition area, poster presentation area and GearArena

Lecture Room B



**Simulation and optimization**

**Moderation:** Dipl.-Ing. Christian Hartmann, Magna PT B.V. & Co. KG, Germany/Prof. h. c. Dr.-Ing. Aizoh Kubo, Research Institute for Applied Sciences, Kyoto, Japan

**Study electromechanically coupled dynamic characteristics of the transmission system of wind turbines**

- Establishing the electromechanical coupling model considering the internal excitation of gear system and the electromagnetic characteristics of the generator
- Effects of different structural parameters of the generator on the dynamic characteristics of the gear system

**Ruibo Chen, Ph. D.**, The State Key Lab of Mechanical Transmissions, Chongqing University, China

**Gear typical fault modeling and fault signal characteristic analysis**

- Gear typical fault modeling
- Analysis of gear fault characteristic signal

**Wenjin Bei, M. Sc.**, Prof. Hui Liu, Professor, Pu Gao, Ph. D., Research Assistant, School of Mechanical Engineering, Beijing Institute of Technology, Beijing, China

**Automation of gearbox design**

- Automation through knowledge-based shaft design and load capacity calculation
- Automated selection of suitable machine elements in gearbox design

**Marius Fürst, M. Sc.**, Research Associate, Institute of Machine Elements, Gear Research Centre (FZG), Technical University of Munich (TUM), Garching, Germany

Lecture Room C



**Worm and crossed helical gears**

**Moderation:** Prof. Dr.-Ing. Georg Jacobs, RWTH Aachen University, Germany/Dr.-Ing. Joachim Thomas, ZG Hypoid GmbH, Germany

**Calculation method for the tooth thickness of cylindrical worm gears**

- Research into tooth thickness characteristics
  - Drawing of tooth profile of cylindrical worm gears
- Prof. Dr. Yaping Zhao**, College of Mechanical Engineering and Automation, Northeastern University China, Shenyang City, China

**Investigation of the meshing friction heat generation of worm gears and the influence of the contact shape**

- Transient thermal behaviour among different pinion machine-setting parameters
  - Influence of worm gear contact pattern on heat generation
- Prof. Dr.-Ing. Aleksandar Miltenović**, Professor, Department for mechanical design, development and engineering, Prof. Dr.-Ing. Milan Banić, Faculty of Mechanical Engineering, University of Niš, Serbia

**Scuffing load capacity calculation of worm gears**

- Contact temperature calculation
  - Safety factor determination
- Philipp Roth, M. Sc.**, Team Leader Worm Gears, Dr. Michael Hein, Department Head Worm and Bevel Gears, Prof. Dr.-Ing. Karsten Stahl, Full Professor, Institute of Machine Elements, Director, Gear Research Centre (FZG), Technical University of Munich (TUM), Garching, Germany

## Lecture Room A



### Multiparameter optimization

**Moderation: Prof. i. R. Dr.-Ing. Bernd-Robert Höhn**, Technical University of Munich (TUM), Germany/**Prof. Ahmet Kahraman**, The Ohio State University, USA

#### 11:00 A comprehensive, fully parametrized calculation model for improved helical-hypoid gearbox efficiency

- Automated multi-parameter sensitivity study via digital twin
- Enhanced efficiency and life span for a modular gearbox system

**Dipl.-Ing. (FH) Ermalt Lamaj, M. Sc.**, Computational Engineer, Dipl.-Ing. (FH) Jens Blömeke, Development Engineer, Dipl.-Ing. Felix Rudolph, Development Engineer, Development Gear Units, SEW-Eurodrive GmbH & Co. KG, Bruchsal, Germany

#### 11:30 Sustainable and multi-criterion optimization of helical gear unit

- Study of the impact of taking the complete transmission in two approaches
- Macro and micro-geometry parameters used as decision variables

**Dipl.-Ing. Emna Ben Younes**, LaMCoS, INSA-Institut National des Sciences Appliquées de Lyon, Villeurbanne, Cedex, France; Prof. Dr.-Ing. Christophe Changenet, Research and R&D director, ECAM, Lyon, Dr.-Ing. Emmanuel Rigaud, Associate Professor, LTDS – Laboratoire de Tribologie et Dynamique des Systemes, Ecole Central de Lyon, France

#### 12:00 Gear design optimization for multi-mesh and multi-power flow transmissions under a broad torque range incorporated with multi-body simulations

- Complex gear train system design optimization with a wide range of torques
- Mult-body simulation for accurate gear contact analysis

**Daehyun Park, Ph. D.**, Research Engineer Advanced, Gear Train System Design and Analysis, Tommaso Tamarozzi, Ph. D., Senior Research Engineering Manager, 3D Motion Research and Technology Development, Siemens Industry Software NV, Leuven, Belgium; Yeohyeon Gwon, M. Sc., Senior Research Engineer, DCT Development, Hyundai Motor Company, Gyeonggi-Do, Korea

#### 12:30 Closing remarks

#### 12:45 Awarding of the best presentation for junior engineers by Prof. Dr.-Ing. Karsten Stahl, FZG, Technical University of Munich (TUM), Garching, Germany

**Awarding of the best paper by Dr.-Ing. Franz Völkel**, Sr. Vice President R&D, Business Division Transmission Systems, Schaeffler Technologies AG & Co. KG, Herzogenaurach, Germany

+ Lunchtime snack

#### 14:15 End of the conference

## Lecture Room B



### Material and heat treatment

**Moderation: Dr.-Ing. Bernhard Bouché**, Getriebbau NORD GmbH & Co. KG, Germany/**Ir. J.J. Bos**, Bos Gear Solutions, The Netherlands

#### Influence of case hardness depth on tooth interior fatigue fracture

- Parameter study of flank fracture
- Comparison of different influences such as case hardness depth, material quality

**Dipl.-Ing. Jean-André Meis**, Senior Specialist Simulation and Data Analytics, Gearbox Development, Dr.-Ing. Matthias Walkowiak, Chief Engineer, Envision Energy CoE GmbH, Dortmund, Germany

#### Deep nitriding – contact and bending strength of gears with increased nitriding hardening depth

- Increasing the load carrying capacity by deep nitriding
- Influence of case properties after nitriding

**André Sitzmann, M. Sc.**, Research Associate, Institute of Machine Elements, Gear Research Centre (FZG), Technical University of Munich (TUM), Garching, Germany; Dr.-Ing. Stefanie Hoja, Senior Research Fellow, Leibniz Institute for Materials Engineering – IWT, Bremen, Germany; Dr.-Ing. Stefan Schurer, Head of Industrial Engineering, Department for Driven Axles and Transfer Gear Boxes, MAN Truck Bus SE Munich, Germany

#### Steel-steel QN-worm gear and its implementation in gearboxes

- Advantages of manufacture and the performance characteristics of a new variety of steel-steel worm type gear
- Quantitative and qualitative comparison with worm and spiroid gears

**Evgeniy Trubachev, D. Sc.**, Professor, Institute of Mechanics, Kalashnikov Izhevsk State Technical University, & Head, Small Innovative Enterprise “Mechanic” Ltd, Izhevsk, Russia; Alexander M. Sannikov, Junior Researcher, Designing Engineer, Alyona I. Shutkina, Designing Engineer, Institute of Mechanics, Kalashnikov Izhevsk State Technical University, Izhevsk, Russia

## Lecture Room C



### High speed gears

**Moderation: Dr.-Ing. Burkhard Pinnekamp**, Renk GmbH, Augsburg & Research Association for Drive Technology (FVA), Germany/**Luc Amar, Ph. D.**, CETIM (Technical Center for Mechanical Engineering Industries), France

#### Scuffing of cylindrical gears with pitch line velocities up to 100 m/s

- Influence of pitch line velocity on the scuffing load capacity
- Improved approach to calculate scuffing

**Jaacob Vorgerd, M. Sc.**, Research Assistant, Prof. Dr.-Ing. Peter Tenberge, Full Professor, Chair of Industrial and Automotive Drivetrains, Ruhr-University Bochum; Dr.-Ing. Manuel Joop, Development engineer, Envision Energy CoE GmbH, Dortmund, Germany

#### Dynamic characteristics of high-speed train gearboxes

- Influence of the wheel-rail excitation on the gearbox
- Influence of the curve radius of railway line

**Dr. Hao Wu**, Assistant Researcher, College of Mechanical and Vehicle Engineering, Prof. Jing Wei, College of Mechanical and Vehicle Engineering, Chongqing University, China; Prof. Pingbo Wu, State Key Laboratory of Traction Power, Southwest Jiaotong University, China

#### FE analysis and predication on the traveling wave resonance of aero-gears

- FE modelling strategy for high-speed gears
- Vibration reduction technology for high-speed meshing

**Xingyuan Zheng**, Dr. Yumei Hu, Professor, State Key Laboratory of Mechanical Transmission, Chongqing University, China

## Location/Venue



The Gear Research Centre (FZG) of the Technical University of Munich has comprehensive facilities for examination and testing of machine elements, such as gears, bearings, synchronizations and couplings. Based on the research results developed here during the past decades, FZG is the leading international research institute for gears and transmissions today. Development and validation of methods and tools of reliable determination of fatigue life, efficiency, and vibration characteristics of gears and transmission elements are in focus of research activities at FZG. Implementation of the research is carried out in close cooperation with industry and standardization organizations, funded either through public research grants or industrial collective and contract research.

### International Conference on Gears 2021

Technische Universität München  
(Technical University of Munich)

Institute of Machine Elements  
Gear Research Centre (FZG)  
Boltzmannstr. 15  
85748 Garching, Germany

### How to find us

Find all travel information at a glance!  
[www.fzg.mw.tum.de/en/fzg/contact](http://www.fzg.mw.tum.de/en/fzg/contact)



## Contact person – the team of the VDI Wissensforum



### Concerning the content:

Caroline Koerber  
Phone: +49 211 6214-504  
Fax: +49 211 6214-97504  
Email: [koerber@vdi.de](mailto:koerber@vdi.de)



### Concerning the organisation

Pia Hofmann-Malcher  
Phone: +49 211 6214-363  
Fax: +49 211 6214-97363  
Email: [hofmann@vdi.de](mailto:hofmann@vdi.de)







**P1 Computation of dynamic transmission error for gear transmission systems using modal decomposition and Fourier series**

**Eddy Abboud, M. Sc.**, LISPEN, Arts et Métiers Institute of Technology, Lille Cedex, France

**P2 Integrated optimization of structural and control parameters for a hybrid electric system**

**Lin Bo, B. E.**, School of Mechanical Engineering, Beijing Institute of Technology, China

**P3 Efficiency improvement and surface protection by using particle-based phyllosilicate-additive**

**Dr. rer. nat. Petr Chizhik**, Lead Application Scientist, Rewitec GmbH (CRODA International PLC.), Lahnau, Germany

**P4 An approach on contact analysis for micro geometry optimization of the gear unit HypoGear**

**Florian Eigner, M. Sc.**, Professur Montage- und Handhabungstechnik (MHT), Institut für Füge- und Montagetechnik (IFMT), Technische Universität Chemnitz, Germany

**P5 Material database for the mechanical design of components made of powder metallurgy material**

**Miao Jiacheng, M. Sc.**, State Key Laboratory of Mechanical Transmission, Chongqing University, China

**P6 Plastic gear remaining useful life prediction using artificial neural network**

**Bui Huy Kien, M. Sc.**, Faculty of Mechanical Engineering, Kyoto Institute of Technology, Japan

**P7 Tooth root fillet optimization of cylindrical gear**

**Egor Kozharinov, Ph. D.**, Head of group, Strength, resource and optimal design of aviation drives, Central Institute of Aviation Motors (CIAM), Moscow, Russia

**P8 Online high resolution wear measurement – a powerful tool for the analysis of initial stages of wear**

**Dr.-Ing. Dominic Linsler**, Deputy group leader, Mikrotribologie Centrum µTC, Fraunhofer Institute for Mechanics of Materials IWM, Karlsruhe, Germany

**P9 Research into the optimization of tooth profile modification based on a high precision three-dimensional finite element model of helical gears**

**Dr. Yanping Liu**, Research Assistant, College of Mining and Safety Engineering, Shandong University of Science and Technology, Qingdao, China

**P10 Quality inspection of common step gearings – overview of different types and their assessment**

**Dr.-Ing. Karsten Lübke**, Software development special geometries, Hexagon Metrology GmbH, Wetzlar, Germany

**P11 Calculating component temperatures in gearboxes for transient operation conditions**

**Constantin Paschold, M. Sc.**, Research Associate, Department EHL-Tribological-Contact and Efficiency, Institute of Machine Elements, Gear Research Centre (FZG), Technical University of Munich (TUM), Garching

**P12 Relationship between cumulative stress during running-in process and pitching fatigue life**

**Masaru Nakao**, Bachelor of Engineering, Tokyo Institute of Technology, Department of Mechanical Engineering, School of Engineering, Tokyo, Japan

**P13 Effect of wear on load ratio during the running-in process**

**Josi Ayu Wulandari Pratama**, Bachelor of Engineering, Tokyo Institute of Technology, Department of Mechanical Engineering, School of Engineering, Tokyo, Japan

**P14 Light in the Black Box: identifying unknown mechanisms of action with AI software and solving acoustic/NVH problems of the gears – practical example of car power train**

**Dipl.-Ing. (FH) Frank Thurner**, Managing Director, Management, Lean Six Sigma Master Black Belt, mts Consulting & Engineering GmbH, Fürstenfeldbruck, Germany

**P15 Advanced method of cutting spiroid, worm and bevel gear-wheel teeth by running cutter head double-stage gearboxes for pipeline valves**

**Evgeniy Trubachev, D. Sc.**, Professor, Institute of Mechanics, Kalashnikov Izhevsk State Technical University, & Head, Small Innovative Enterprise "Mechanic" Ltd, Izhevsk, Russia

**P16 Dynamic analysis of a gear-shaft system with the distributed parameter shaft**

**Zhen Wang, M. Sc.**, School of Mechanical Engineering, Beijing Institute of Technology, China

**P17 The influence of thermal deformation on spur gear dynamic modification**

**Pengfei Yan, M. Sc.**, School of Mechanical Engineering, Beijing Institute of Technology, China

**P18 Coupling analysis of control parameters and mechanical parameters in torsional vibration of electro-mechanical transmission**

**Wei Zhang, M. Sc.**, School of Mechanical Engineering, Beijing Institute of Technology, China

**P19 Vibration characteristics of gear system with a cracked gear tooth: modelling and experiments**

**Songtao Zhao, M. Eng.**, Development Engineer, School of Aerospace Engineering and Applied Mechanics, Tongji University, Shanghai, China

**P20 Thermal deformation characteristic of gear hobbing based on multivariable integrated model**

**Zheyu Li, B. Eng.**, State Key Laboratory of Mechanical Transmission, Chongqing University, China

**P21 Design method for global properties of point-contact tooth surface based on envelope-approximation theory**

**Prof. Kaihong Zhou, Ph. D.**, Professor, Engineering Mechanics, Mechanical transmission, Robot and CNC Manufacture Technology for Sculptured Surface, College of Mechanical and Control Engineering, Guilin University of Technology, China

**P22 Research into tooth flank twist compensation in continuously generating grinding gear based on a flexible electronic gearbox**

**Lei Zhou**, Research Center, School of Mechanical Engineering, Hefei University of Technology, China



Combined with 5-minute talks!

Free of charge  
for participants of the "International  
Conference on Gears 2021"



## 4th International Conference on Gear Production 2021

September 15 - 17, 2021, Garching/Munich, Germany



Source: © WZL, RWTH Aachen/Anmad

### Key topics:

- Increasing productivity in gear skiving
- Higher tool life for hard finishing processes
- Improved gear-quality inspection
- Methods for designing and manufacturing face, bevel and worm gears
- Improved tribo system within the manufacturing process
- Enhanced simulation methods for improving the gear manufacturing process

### Presidency:

**Prof. Dr.-Ing. Thomas Bergs**, Full Professor, Laboratory for Machine Tools and Production Engineering (WZL), Chair of Manufacturing Technology, Faculty for Mechanical Engineering, RWTH Aachen University, Germany

**Prof. Dr.-Ing. Christian Brecher**, Full Professor, Chair of Machine Tools, Laboratory for Machine Tools and Production Engineering (WZL), Faculty for Mechanical Engineering, RWTH Aachen University, Germany

**Prof. Dr.-Ing. Karsten Stahl**, Full Professor, Institute of Machine Elements, Director, Gear Research Centre (FZG), Technical University of Munich (TUM), Garching, Germany

### With experts from:

Applied Nano Surfaces Sweden | Balance Drive | Georgii Kobold | Gleason Corporation | Hexagon Metrology | Involute Simulation Softwares | Mitsubishi Heavy Industries Machine Tool | OTTO FUCHS Dülken | Physikalisch-Technische Bundesanstalt | SEW-Eurodrive

Further details and the final program can be found here:

[www.vdicongference.com/02TA411021](http://www.vdicongference.com/02TA411021)

## 4th International Conference on High Performance Plastic Gears 2021

September 15 - 17, 2021, Garching/Munich, Germany



Source: © Firmenarchiv Scholz-HTIK

### Key topics:

- Latest developments for the enhanced performance of plastic gears
- Status and future of standardized plastic gear strength calculation
- High performance plastic gear applications
- Potential of composite gears with fiber reinforcement
- Lubrication and tribology of plastic gears

### Presidency:

**Prof. Dr.-Ing. Karsten Stahl**, Full Professor, Institute of Machine Elements, Director, Gear Research Centre (FZG), Technical University of Munich (TUM), Garching, Germany

### Conference Board:

**Dr.-Ing. Marco Baccalaro**, Chassis Systems Control, Gear Development and Test Conception/Realization, Robert Bosch GmbH, Heilbronn, Germany

**Dipl.-Ing. Klemens Humm**, Manager Gear Development, Corporate Research and Development, ZF Friedrichshafen AG, Friedrichshafen, Germany

**Dr.-Ing. Ulrich Kissling**, President, KISSsoft AG, Bubikon, Switzerland

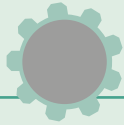
**Dr.-Ing. Andreas Langheinrich**, Development Drive Technology, Horst Scholz GmbH & Co. KG, Kronach, Germany

### With experts from:

DSM Engineering Materials | Evonik Operations | Gear Transmission Solutions | IMS Gear | KISSsoft | KURARAY | Leibniz-Institut für Verbundwerkstoffe | Longato Riccardo | Podkrižnik | Robert Bosch | ZF Friedrichshafen

Further details and the final program can be found here:

[www.vdicongference.com/02TA409021](http://www.vdicongference.com/02TA409021)



## GearArena

### Gather hands-on experience in the transmission world!

Take a look at individual gear components, gain an insight into how the different components interact and compare design and workmanship! You will find an on-site contact person from the exhibitor to answer all your questions.



## FZG lab tours

### Get the chance to visit innovative laboratory facilities!

Seize the opportunity and visit the nearby test and laboratory facilities at the Gear Research Centre (FZG). Several guided tours with different core topics offer opportunities of gaining deeper insights into a variety of innovative gear test rigs and laboratory equipment. For registration meet at the FZG information desk during the conference.



## Speakers meet up

### Do you still have unresolved questions?

You can address your questions to the speakers right after the lecture during the coffee break. Take the chance to say hello to your favorite speaker and to connect with them. They will be available for at least 15 minutes after their session.



## Poster exhibition with impulse talks

### The poster exhibition is combined with a 5-minute talk.

The compact style of presentation called the '5-minute rapid' presentation, will provide you with all information in a clear, succinct manner. Poster presentations are scheduled during the coffee breaks. Presentation times will be announced on-site.



## Two gear community nights

### Your networking hotspot for the international gear community!

Enjoy the evening reception at the Hofbräuhaus as well as another social event on the second conference day at the university. The Hofbräuhaus is the cradle of Bavarian tavern culture – the origin of tradition, "Gemütlichkeit" and hospitality. Both – the get-together at the FZG and the brewery visit – offer you an excellent opportunity to network with your peers and catch up on trends.



Source: Hofbräuhaus Munich, Germany



## Presidency



### Conference president

**Prof. Dr.-Ing. Karsten Stahl**, Full Professor, Institute of Machine Elements, Director, Gear Research Centre (FZG), Technical University of Munich (TUM), Garching, Germany



### Conference Board/Vice President:

**Dr.-Ing. Bernhard Bouché**, Director of Research and Development Mechanics, Getriebebau NORD GmbH & Co. KG, Bargteheide, Germany



**Prof. i. R. Dr.-Ing. Bernd-Robert Höhn**, TUM emeritus of excellence, Gear Research Centre (FZG), Technical University of Munich (TUM), Garching, Germany



**Dr.-Ing. Burkhard Pinnekamp**, Head of Central Technology, Renk GmbH, Augsburg; President, Research Association for Drive Technology (FVA), Frankfurt, Germany

## Board of Gear Excellence

**Ir. J.J. Bos**, Technical Consultant, Bos Gear Solutions, Middelburg, The Netherlands

**Prof. Dr. Eng. Jože Duhovnik**, Full Professor, former Dean and Head of LECAD Group, Laboratory, Faculty for Mechanical, Engineering, University of Ljubljana, Slovenia

**Prof. Dr.-Ing. Manfred Hirt**, Past President, Research Association for Drive Technology (FVA), Frankfurt/Main; former board of Renk GmbH, Augsburg, Germany

**Prof. Haruo Houjoh**, Emeritus Professor, Tokyo Institute of Technology, Japan

**Prof. h.c. Dr.-Ing. Aizoh Kubo**, General Manager, Research Institute for Applied Sciences, Kyoto, Japan

**Prof. Dr.-Ing. habil. Heinz Linke**, Emeritus Professor, Institute of Machine Elements and Machine Design, Faculty of Mechanical Science and Engineering, Technical University of Dresden, Germany

**Dr. Michel Octrue**, former Senior Gear Expert Mechanical Power Transmissions, CETIM (Technical Center for Mechanical Engineering Industries), Senlis, France

**Prof. Ray Snidle**, Emeritus Professor of Mechanical Engineering, Cardiff University, United Kingdom

**Dr.-Ing. Toni Weiss**, Gear Consultant, ret. from Renk GmbH, Augsburg, now GanaCon – Gear analysis and Consulting, Inning, Germany

## National Members

**Prof. Dr.-Ing. Dr. h. c. Albert Albers**, Full Professor and Head of IPEK – Institute of Product Engineering, Department of Mechanical Engineering, Karlsruhe Institute of Technology (KIT)

**Dr.-Ing. Heinz-Uwe Arnscheidt**, Head of Dynamic and Duty Cycle Simulation, Volkswagen AG, Wolfsburg

**Dr.-Ing. Jörg Börner**, Gear Fundamentals & Programs, Mechatronics Engineering & Technologies, ZF Friedrichshafen AG

**Prof. Dr.-Ing. Christian Brecher**, Full Professor, Chair of Machine Tools, Laboratory for Machine Tools and Production Engineering, Faculty for Mechanical Engineering, RWTH Aachen University

**Dr.-Ing. Rolf Döbereiner**, Product Line Manager Commercial Vehicles, AVL List GmbH, Graz, Austria

**Dr.-Ing. Hartmut Faust**, Head of R&D Competence, Schaeffler Automotive Buehl GmbH & Co. KG, Bühl

**Dipl.-Ing. (FH) Hans-Peter Fleischmann**, Manager Technical Development Dual-Clutch Transmissions and Advanced Development Transmission, AUDI AG, Ingolstadt

**Dr.-Ing. Carsten Gitt**, Senior Manager, Simulation/Mechatronics/Advanced Engineering (Drivetrain/Transmission), Mercedes-Benz AG, Stuttgart

**Dipl.-Ing. Norbert Haefke**, Managing Director, Research Association for Drive Technology (FVA), Frankfurt/Main

**Dipl.-Ing. Christian Hartmann**, Senior Manager Gear Design & Material, Magna PT B.V. & Co. KG, Untergruppenbach, Germany

**Dr.-Ing. Jörg Hermes**, Managing Director, Innovation Mechanics, SEW-Eurodrive GmbH & Co. KG, Bruchsal

**Dr.-Ing. Ralf Hess**, Senior Key Expert, Flender GmbH, Bocholt

**Prof. Dr.-Ing. Georg Jacobs**, Head of Institute for Machine Elements and Systems Engineering, RWTH Aachen University

**Dr.-Ing. Andreas Klein**, Vice President Engineering, Flender GmbH – Winergy, Voerde

**Dr.-Ing. Kai Lubenow**, Director Engineering, Eickhoff Antriebstechnik GmbH, Bochum

**Prof. Dr.-Ing. Gerhard Poll**, Director, Institute for Machine Design and Tribology, Leibniz University Hannover

**Dipl.-Ing. Zsolt Roth**, Development Engineer – Tothing, J. M. Voith SE & Co. KG | VTA, Heidenheim

**Prof. Dr.-Ing. Bernd Sauer**, Full Professor, Head of MEGT – Institute of Machine Elements, Gears and Transmission, Department of Mechanical and Process Engineering, Technische Universität Kaiserslautern

**Prof. Dr.-Ing. Berthold Schlecht**, Full Professor, Institute of Machine Elements and Machine Design, Faculty of Mechanical Science and Engineering, Technical University of Dresden

**Prof. Dr.-Ing. Peter Tenberge**, Full Professor, Chair of Industrial and Automotive Drivetrains, Ruhr-University Bochum

**Dr.-Ing. Joachim Thomas**, Managing Director, ZG Hypoid GmbH, Aschheim

**Dr.-Ing. Franz Völkel, Sr.** Vice President R&D, Business Division Transmission Systems, Schaeffler Technologies AG & Co. KG, Herzogenaurach

**Dr.-Ing. Reiner Vonderschmidt**, Shareholder, Georgii Kobold GmbH & Co. KG, Horb



## International Members

**Eng. Amir Aboutaleb**, Vice President, Technical Division, American Gear Manufacturers Association, Alexandria, USA

**Luc Amar, Ph. D.**, Research Engineer, Power Transmissions (TDP), CETIM (Technical Center for Mechanical Engineering Industries), Senlis Cedex, France

**Prof. Bingkui Chen**, The State Key Lab of Mechanical Transmissions, Chongqing University, China

**Prof. Ing. Carlo Gorla**, Associate Professor, Department of Mechanical Engineering, Politecnico di Milano, Italy

**Prof. Ahmet Kahraman**, Howard D. Winbigger Professor and Director, Gear and Power Transmission Research Laboratory, Department of Mechanical and Aerospace Engineering, The Ohio State University, Columbus, USA

**Dr.-Ing. Alex Kapelevich**, Consultant, AKGears, LLC, Shoreview, Minnesota, USA

**Prof. Dr. Geng Liu**, Full Professor, School of Mechanical Engineering, Northwestern Polytechnical University; Director, Shaanxi Engineering Laboratory for Transmissions and Controls, Xi'an, China

**Prof. Dr.-Ing. Athanassios Mihailidis**, Full Professor, Head of the School of Mechanical Engineering, Laboratory of Machine Elements and Machine Design, Aristotle University of Thessaloniki, Greece

**Prof. Dr.-Ing. Aleksandar Miltenović**, Professor, Department for mechanical design, development and engineering, Faculty of Mechanical Engineering, University of Niš, Serbia

**Prof. Dr. Eng. Ichiro Moriwaki**, Professor, Faculty of Mechanical Engineering, Kyoto Institute of Technology, Kyoto, Japan

**Robin Olson, M. Sc.**, Director of Applications Engineering, Material Handling Vertical, Rexnord Industries, LLC, Milwaukee, Wisconsin, USA

**Prof. Dr.-Ing. José I. Pedrero**, Full Professor, Department of Mechanics, Faculty of Engineering, Universidad Nacional de Educación a Distancia (UNED), Madrid, Spain

**Prof. Dr. Datong Qin**, Full Professor of the State Key Lab of Mechanical Transmission, Distinguished Professor of Cheung Kong Scholars appointed by Ministry of Education of China, Director of the Institute of Power Transmission and control, Chongqing University, China

**Prof. Dr.-Ing. Philippe Velez**, Full Professor, LaMCoS, INSA – Institut National des Sciences Appliquées de Lyon, Villeurbanne Cédex, France

**Prof. Wenzhong Wang**, School of Mechanical Engineering, Beijing Institute of Technology, China

**Prof. Dr.-Ing. Michael Weigand**, Full Professor and Head of Research Unit – Institute for Engineering Design and Product Development (IKP), Research Unit Machine Elements and Transmissions for Aviation, TU Wien, Vienna, Austria

## Scientific support

### VDI Society Product and Process Design

The VDI SOCIETY PRODUCT AND PROCESS DESIGN (VDI-GPP) and its technical divisions provide all sectors with verified knowledge on the design of products and processes and their optimization in terms of quality and the time- and cost-benefit ratio.

[www.vdi.eu](http://www.vdi.eu)



### The Event App

Becoming available shortly!

### Plan your visit in advance and get to know all the details of the International Conference on Gears 2021!


Make use of this full-service app for your visit to the International Conference on Gears 2021 – the International Expo and Conference for connected car and mobility solutions: You can not only plan your stay in Garching but also make use of the networking possibilities the app offers you.



## Become an exhibitor or sponsor!

Would you like to get face to face with the high-powered delegates attending this VDI conference and present your products and services to a specialist sector of your market? For an optimum presentation of your company, make use of the exhibition held in parallel with the conference.

Here you can meet industry decisionmakers – make your target contacts neatly and without a great deal of organisational outlay. Secure your stand space right at the heart of this industry rendezvous and/or use a sponsorship package specially tailored to your requirements to enable you to stand out more clearly and effectively from your competitors. We can supply you with exclusive communication possibilities before, during and after the event.

**Your contact person:**  
 Vanessa Ulbrich  
 Project Consultant Exhibition & Sponsorship  
 VDI Wissensforum GmbH  
 VDI-Platz 1  
 40468 Duesseldorf, Germany

Phone: +49 211 6214-918  
 Fax: +49 211 6214-97918  
 Email: [ulbrich@vdi.de](mailto:ulbrich@vdi.de)

## List of exhibitors

(May 2021)

ELTRO Gesellschaft  
 Evonik Operations GmbH  
 FRESCO GmbH  
 GEORGII KOBOLD GmbH & Co. KG  
 IMS Gear SE & Co. KGaA

KISSsoft AG  
 Metal Improvement Company Inc.  
 SMT  
 Telemetrie Elektronik GmbH

## The participants – your customers

### Attendees in 2019

Experts:

46 %

Project manager:

25 %

Production engineer:

17 %

Project management:

7 %

Others:

5 %

Research and Development:

40 %

University/research institutions:

18 %

Construction and development:

17 %

Production:

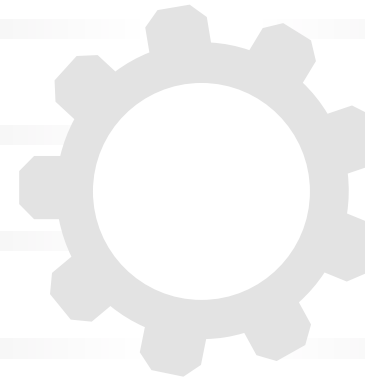
9 %

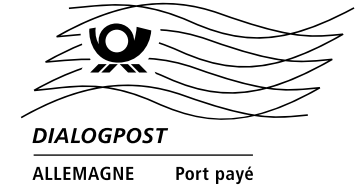
Sales:

9 %

Others:

7 %





Ticket includes entrance to the parallel conferences:  
• Gear Production 2021  
• High Performance Plastic Gears 2021

VDI Wissensforum GmbH | VDI-Platz 1 | 40468 Duesseldorf | Germany

✓ Please register for (price per person plus VAT):

1111

### International Conference on Gears 2021

September 15 - 17, 2021, Garching near Munich, Germany

Early bird price until July 1<sup>st</sup>, 2021  
EUR 1,490.-

From July 2<sup>nd</sup>, 2021  
EUR 1,590.-

Participation fee for personal VDI members and members of associated organisations of the International Conference on Gears 2021  
**save EUR 50.- each conference day**

VDI membership no.\*: \_\_\_\_\_

\* For this price category, please state your VDI membership number or the name of the associated organisation (outlined at the homepage [www.vdi-gears.eu](http://www.vdi-gears.eu))

I'm interested in sponsoring and/or the exhibition

You need help?

Please contact us!

Phone: +49 211 6214-201

Fax: +49 211 6214-154

Email: [wissensforum@vdi.de](mailto:wissensforum@vdi.de)

[www.vdi-gears.eu](http://www.vdi-gears.eu)

First Name \_\_\_\_\_ Last Name (Family Name) \_\_\_\_\_

Title \_\_\_\_\_ VAT-ID \_\_\_\_\_

Company/Institute \_\_\_\_\_ Job Title \_\_\_\_\_ Department \_\_\_\_\_

Street \_\_\_\_\_

ZIP Code, City, Country \_\_\_\_\_

Phone \_\_\_\_\_ Email \_\_\_\_\_ Fax \_\_\_\_\_

Deviating bill address \_\_\_\_\_

Participants with an invoice address outside of Austria, Germany and Switzerland are kindly requested to pay by credit card. Please don't send your credit card details via email, fax or post. Please book your ticket at [www.vdi-gears.eu](http://www.vdi-gears.eu). Transferring your credit card details via our website ensures your details are encrypted and security of your data is guaranteed.

General terms and conditions of VDI Wissensforum can be found online at:  
[www.vdi-wissensforum.de/en/terms-and-conditions/](http://www.vdi-wissensforum.de/en/terms-and-conditions/)

Venue:

Conference: Technische Universität München (Technical University of Munich), Institute of Machine Elements, Gear Research Centre (FZG), Boltzmannstraße 15, 85748 Garching, Germany, [www.mw.tum.de/en/fzg/home/](http://www.mw.tum.de/en/fzg/home/)

Hotel Reservation: A limited number of rooms have been reserved for conference participants. For booking please visit [www.vdi-gears.eu](http://www.vdi-gears.eu) where you will find a link for special room rates.

More Hotels close to the congress venue may be found via our HRS service.  
[www.vdi-wissensforum.de/hrs](http://www.vdi-wissensforum.de/hrs)



Information: The price includes conference documents (e-book), coffee breaks, and beverages during breaks, lunches and two evening receptions

Exclusive offer: All participants at this event are entitled to a free three-month trial VDI membership. (Offer applies exclusively to new members.)

Data protection: VDI Wissensforum GmbH uses the email address you have provided to regularly inform you about similar VDI Wissensforum GmbH events. If you would no longer like to receive any information or offers, you can object to your data being used for this purpose at any time. To do so, use the following email address [wissensforum@vdi.de](mailto:wissensforum@vdi.de) or one of the other contact possibilities mentioned above.

We would like to make you aware of general information about the usage of your data here:  
<https://www.vdi-wissensforum.de/en/privacy-policy/>

I hereby agree to VDI's terms and conditions and confirm that the data I have provided to register above is correct. Your contact data was obtained based on article 6, paragraph, sentence 1 lit. f) DSGVO (legitimate interest). Our legitimate interest is to select a precise selection of possible interested parties for our events. You can get more information about the source and usage of your data here:  
<https://www.vdi-wissensforum.de/en/source-of-address/>

