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

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

High Performance Plastic Gears 2021
www.vdiconference.com/02TA409021

An event organized by VDI Wissensforum
www.vdi-gears.eu
1st Conference day
Wednesday, September 15th, 2021

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

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

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

Parallel sessions

International Conference on Gears

Lecture Room A
- 13:30 Determining tooth root strength

Lecture Room B
- 15:00 Coffee break – meet & greet in the exhibition area, poster presentation area and GearArena
- 16:00 Loaded tooth contact analysis

Lecture Room C
- 15:00 Coffee break – meet & greet in the exhibition area, poster presentation area and GearArena
- 16:00 Non-involute and asymmetric gears

Lecture Room D
- 16:00 Condition monitoring/smart gears

Lecture Room E
- 18:00 Material properties

Parallel conferences – free of charge –

International Conference on Plastic Gears
www.vdiconference.com/027A4i09021

International Conference on Gear Production
www.vdiconference.com/027A4i11021

- 18:00 Condition monitoring/smart gears
- 19:00 Material properties
- 20:00 Innovative manufacturing processes

19:00 Evening reception at the Hofbräuhaus in Munich

Dinner Speech: Prof. 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 16th, 2021**

<table>
<thead>
<tr>
<th>Time</th>
<th>Lecture Room A</th>
<th>Lecture Room B</th>
<th>Lecture Room C</th>
<th>Lecture Room D</th>
<th>Lecture Room E</th>
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<tbody>
<tr>
<td>08:30</td>
<td>Gear strength</td>
<td>Wear</td>
<td>Bevel and Hypoid Gears</td>
<td>Gear strength testing</td>
<td>Gear soft machining</td>
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<tr>
<td>10:00</td>
<td>Coffee break – meet &amp; greet in the exhibition area, poster presentation area and GearArena</td>
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<tr>
<td>11:00</td>
<td>Planetary gears</td>
<td>Gear geometry optimization</td>
<td>Enhanced testing methods</td>
<td>Standardization of strength calculation</td>
<td>New concepts for machine and manufacturing processes</td>
</tr>
<tr>
<td>12:30</td>
<td>Time for working lunch – meet &amp; greet in the exhibition area, poster presentation area and GearArena</td>
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<tr>
<td>14:00</td>
<td>Gear dynamics</td>
<td>Operating data acquisition</td>
<td>FEM analysis</td>
<td>Geometrical effects</td>
<td>Advances in special gearings</td>
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<tr>
<td>15:30</td>
<td>Coffee break – meet &amp; greet in the exhibition area, poster presentation area and GearArena</td>
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<tr>
<td>16:30</td>
<td>Gear strength – flank properties</td>
<td>CFD – churning and windage losses</td>
<td>Quality assurance and measurement</td>
<td>Temperature effects</td>
<td>Modeling in gear production</td>
</tr>
<tr>
<td>18:00</td>
<td>Evening reception at the conference venue</td>
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</table>

**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**

#### 3rd Conference day
**Friday, September 17th, 2021**

<table>
<thead>
<tr>
<th>Time</th>
<th>Lecture Room A</th>
<th>Lecture Room B</th>
<th>Lecture Room C</th>
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<th>Lecture Room E</th>
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<tbody>
<tr>
<td>08:30</td>
<td>Friction</td>
<td>Simulation and optimization</td>
<td>Worm and crossed helical gears</td>
<td>Lubrication</td>
<td>Measurement technology</td>
</tr>
<tr>
<td>10:00</td>
<td>Coffee break – meet &amp; greet in the exhibition area, poster presentation area and GearArena</td>
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<tr>
<td>11:00</td>
<td>Multiparameter optimization</td>
<td>Material and heat treatment</td>
<td>High speed gears</td>
<td>Tribological investigation</td>
<td>Gear hard machining</td>
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<tr>
<td>12:30</td>
<td>Closing remarks</td>
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<td>Closing remarks</td>
<td>Closing remarks</td>
<td>Closing remarks</td>
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<tr>
<td>12:45</td>
<td>Awarding of the best presentation for junior engineers by Prof. Dr.-Ing. Karsten Stahl, FZG, Technical University of Munich (TUM), Garching, Germany</td>
<td>Awarding of the best paper by Dr.-Ing. Franz Völkel, Sr. Vice President R&amp;D, Business Division Transmission Systems, Schaeffler Technologies AG &amp; Co. KG, Herzogenaurach, Germany</td>
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<tr>
<td>14:15</td>
<td>End of the conferences</td>
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</table>
1st Conference day
Wednesday, September 15th, 2021

08:30 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

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

10:15 - 12:00
Keynote session: Innovation flashlights: What will be the next game-changing innovations and technologies?
Moderation: Prof. Dr.-Ing. Karsten Stahl, FZG, Technical University of Munich (TUM), Garching, Germany

Demands in gear technology in structural change economy
- High performance in the inflating structure of the economy
- Motive force behind human activity is desire
- Necessary performance in sustainable structure of the economy

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

The innovator’s DNA
- Exploration
- Acceleration
- Serendipity


New ways to lubricate
- Sustainability requirements change in raw material landscape
- Sensor technologies – what’s possible
- New basefluids – why not water

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

High performance plastic gears in future applications
- Intelligent plastics material design
- Processing and design freedom of plastic gears
- Evaluation of plastic gears for new mobility vehicles

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
- Lubrication of the contact by escaping lubricant
- Separation of the contact of the Roller pairings, without metallic contact
- Influence of the surface structure

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

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

Every participant gets a voice – you will be involved via digital polls during the speeches.
### 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 test 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 Alnahlaui, 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

### Lecture Room B

**NVH**

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

- **14:30** 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 Langhans, 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

- **15:00** Gear mesh excitation and non-uniform rational B-splines
  - Tooth contour derived by shaping simulation
  - Numerical modeling with isogeometric analysis
  - Andreas Beinstingel, 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

### 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*

- **13:30** 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

- **14:00** 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 of Metals, Corporate Research, Robert Bosch GmbH, Renningen; Prof. Dr.-Ing. habil. Volker Schuler, Director of Manufacturing and Materials Technology, wbk Institute of Production Science, Karlsruhe Institute of Technology (KIT), Germany

- **14:30** 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

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**Poster presentations**

- **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
### Program

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<th>Lecture Room A</th>
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<tr>
<td><strong>Loaded tooth contact analysis</strong>&lt;br&gt;<strong>Moderation:</strong> Prof. Dr.-Ing. Christian Brecher, RWTH Aachen University, Germany/Dr.-Ing. Reiner Vonderschmidt, Georgii Kobold GmbH &amp; Co. KG, Germany</td>
<td><strong>Non-involute and asymmetric gears</strong>&lt;br&gt;<strong>Moderation:</strong> 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</td>
<td><strong>Condition monitoring/smart gears</strong>&lt;br&gt;<strong>Moderation:</strong> Prof. Dr.-Ing. Dr. h. c. Albert Albers, Karlsruhe Institute of Technology (KIT), Germany/Prof. Dr. Datong Qin, Chongqing University, China</td>
</tr>
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</table>
| 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 | 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 (FZO), Technical University of Munich (TUM), Garching, Germany | 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 Gwisch, 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 |
| 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 Schlechter, Full Professor, Institute of Machine Elements and Machine Design, Faculty of Mechanical Science and Engineering, Technical University of Dresden, Germany | Practical application of asymmetric tooth root geometry for downsizing automotive transmission gears  
- Development of a hub design method for asymmetric tooth tip geometry  
- Validation of the effect on improving the tooth root strength for CVT gears  
Kunihiro Fukanoki, 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 | 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 |
| 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 | 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 | 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 accelerome-ter 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 |
| 16:00 | 16:30 | 18:00 |
| 17:00 | 17:30 | End of the first conference day |
| 18:00 | 19:00 | Organized bus transfer to the evening reception  
Evening reception at the Hofbräuhaus in Munich |

You are invited!

“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.”

Source: @ Hofbräuhaus München

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**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
# 2nd Conference day
Thursday, September 16th, 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

- **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

## Lecture Room B

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

- **08:30** 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

- **09:00** 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

- **09:30** 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 Dehler, 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

- **08:30** 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, Productengineer, DMG/MORI Co. Ltd., Iga, Japan

- **09:00** 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

- **09:30** 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

### Other
- **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
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| **Dynamic load distribution of planetary gear sets subject to both internal and external excitations**  
*Moderation: Dipl.-Ing. Zsolt Roth, J. V. Voith SE & Co. KG | VTA, Germany/Dr.-Ing. Kai Lubenow, Eickhoff Antriebstechnik GmbH, Germany*  
- Dynamic response and contact stress distribution in planetary gears  
- Influence of input torsional excitations  
*Dokadiya 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*  
| **Parametric study of hypocycloidal involute gears**  
*Moderation: Prof. Dr.-Ing. Gerhard Poll, Leibniz University Germany/Prof. Dr.-Ing. Chen Liu, Northwestern Polytechnical University & Shana Engineering Laboratory for Transmissions and Controls, China*  
- 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*  
| **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*  

**Program**

**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  
*Dokadiya 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 Furst, 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*

**11:00 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*

**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 Thelting, 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*

**12:00 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*

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

**13:00 -** Poster presentations in the poster exhibition area
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
16:30 Combining improved gear efficiency and improved fatigue performance through mass finishing
- Fatigue modified by enhanced topography and microstructure
- Fatigue modified by introduced compressive stress

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 Birmanns, 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 Zahnrad 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, Schrozhausen, Germany

Program

17:30 Predicting 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

You are invited!

"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 17th, 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-Irirsarri, Gearbox Section Manager, Gamesa Energy Transmission – SGRE ON, Zamudio, Spain

**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

- **08:30** 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

**Worm and crossed helical gears**

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

- **09:00** 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

**Gear typical fault modeling and fault signal characteristics 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

**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 B**

**Worm and crossed helical gears**

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

- **09:00** 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

- **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

**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

**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 C**

**Worm and crossed helical gears**

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

- **09:00** 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

- **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
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 Ernatt Lamaj, M. Sc., Computer Engineering, 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. Emma Ben Younes, LaMaCoS, 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
- Multi-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

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

13:00 Influence of case hardening depth on tooth interior fatigue fracture
- Parameter study of flank fracture
- Comparison of different influences such as case hardiness 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

14:15 End of the conference

12:45 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

14:15 End of the conference
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

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Find all travel information at a glance!
www.fzg.mw.tum.de/en/fzg/contact

Contact person – the team of the VDI Wissensforum

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P1 Computation of dynamic transmission error for gear transmission systems using modal decomposition and Fourier series
Eddy Abboud, M. Sc., LISIEN, 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., Professor Montage- and 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, Qingsdao, 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
Josy Ayu Wuandari 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, Manage- ment, Lean Six Sigma Master Black Belt, mts Consulting & Engineering GmbH, Fürstenfeldbruck, Germany

P15 Advanced method of cutting spiral, 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
4th International Conference on Gear Production 2021
September 15 - 17, 2021, Garching/Munich, Germany

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:
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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.vdiconference.com/02TA411021

4th International Conference on High Performance Plastic Gears 2021
September 15 - 17, 2021, Garching/Munich, Germany

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:
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Dipl.-Ing. Klemens Humm, Manager Gear Development, Corporate Research and Development, ZF Friedrichshafen AG, Friedrichshafen, Germany
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With experts from:

Further details and the final program can be found here:
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**Gears Interactive – new ideas, more added value for your business**

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### 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.

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### 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.

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### 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.

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### 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.

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### 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.

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Source: Hofbräuhaus Munich, Germany
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Conference president
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Email: ulbrich@vdi.de

List of exhibitors

*(May 2021)*

ELTRO Gesellschaft
Evonik Operations GmbH
FRENCO 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**

<table>
<thead>
<tr>
<th>Function</th>
<th>Experts</th>
<th>Project manager</th>
<th>Production engineer</th>
<th>Project management</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research and Development</td>
<td>46 %</td>
<td>25 %</td>
<td>17 %</td>
<td>7 %</td>
<td>5 %</td>
</tr>
<tr>
<td>University/research institutions</td>
<td>40 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction and development</td>
<td>18 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production</td>
<td>9 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sales</td>
<td>9 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>7 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*The values in the table are estimates and not to be taken as exact figures.*
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)

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General terms and conditions of VDI Wissensforum can be found online at: 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/

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

www.vdi-wissensforum.de/hrs

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

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