

Europe invites the world

# International Conference on Gears 2023

FZG, Garching/Munich, Germany

#vdi\_gears

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## Key topics:

- Sustainable gears with reduced carbon footprint and increased efficiency
- Optimization of gear design and geometry
- New test methods for endurance, efficiency and NVH behavior
- Numerical methods and multiscale simulation tools to improve gear performance
- Smart gears for condition monitoring systems and additional functions
- Life cycle assessment of geared drive systems

## Gears interactive

GearArena  
Speakers meetup  
FZG lab tours  
Poster exhibition  
Two gear community nights

## Associated organisations:



American Gear Manufacturers, USA



ARTEMA, France



ASSIOT, Italy



ASME



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



JSME



The Korean Society of Mechanical Engineers, Korea



Romanian Association of Mechanical Transmissions



Technical Chamber of Greece



WiGeP, Germany

## Visit parallel conferences free of charge



**Gear Production 2023**

[www.vdi-wissensforum.de/02TA411023](http://www.vdi-wissensforum.de/02TA411023)



**High Performance Plastic Gears 2023**

[www.vdiconference.com/02TA409023](http://www.vdiconference.com/02TA409023)



An event organized by VDI Wissensforum

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

### 1st Conference day

Wednesday, September 13<sup>th</sup>, 2023

08:15 Registration

### Plenary lectures

09:30 Common welcome and opening of the

- International Conference on Gears 2023
- International Conference on High Performance Plastic Gears 2023
- International Conference on Gear Production 2023

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

09:55 Welcome address by

**Prof. Dr. sc. tech. Gerhard Kramer**, Senior Vice President Research and Innovation, TUM School of Engineering and Design, Technical University of Munich, Garching, Germany

**Prof. Dr.-Ing. Birgit Vogel-Heuser**, Vice Dean Research and Innovation TUM School of Engineering and Design, Chair of Automation and Information Systems, Technical University of Munich, 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: Re-X: Recycle | Reuse | Reduce

**From why to how: It is time for sustainability to move from the executive agenda into the real world**

**Dominik Leisinger, EMBA**, Partner & Europe Lead Product Excellence (PERLab), A.T. Kearney (International) AG, Zurich, Switzerland

**The need for global standards to define CO<sub>2</sub> footprint in product specifications**

**Erik Claesson, M. Sc.**, Director, Automotive Segment & Group Business Intelligence, Ovako AB, Hofors, Sweden

**Refurbishing tracked vehicle transmissions**

**Dr.-Ing. Burkhard Pinnekamp**, Head of Central Technology, Sebastian Schießler, M. Eng., Head of Repair, Vehicle Mobility Solutions, RENK GmbH, Augsburg, Germany

**Increasing air travel and the challenges to reduce emissions**

**Dr.-Ing. David Krüger**, Design Engineer, R&T Project Manager, Transmissions, Rolls-Royce Deutschland Ltd & Co. KG, Blankenfelde-Mahlow, Germany

**Efficiency-improvement with low-loss-gears by two different applications**

**Prof. i.R. Dr.-Ing. Dr. h.c. Bernd-Robert Höhn**, TUM emeritus of excellence, Michael Geitner, M. Sc., Research Associate, Institute of Machine Elements, Gear Research Center (FZG), TUM School of Engineering and Design, Technical University of Munich, 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

Lecture Room A

Lecture Room B

Lecture Room C

13:30 Tooth root load & carrying capacity

NVH: Impacts

Lubrication

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

16:00 Damage detection

Asymmetric gear geometry

Efficiency and friction

17:30 Evening reception at the university

#### Parallel conferences – free of charge –

**International Conference on Plastic Gears**  
[www.vdi-wissensforum.de/02TA409023](http://www.vdi-wissensforum.de/02TA409023)

**International Conference on Gear Production**  
[www.vdi-wissensforum.de/02TA411023](http://www.vdi-wissensforum.de/02TA411023)

Lecture Room D

Lecture Room E

Sustainability

Innovations in gear production

Tooth root strength

Software in gear production

**2nd Conference day**  
Thursday, September 14<sup>th</sup>, 2023

	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	Load capacity	Planetary gears: Simulation and lubrication	Efficiency: Gearbox	Fibre reinforcement	Additive manufacturing
10:00	Coffee break – meet & greet at the exhibition area, poster presentation area and GearArena				
11:00	Planetary gears: NVH	CFD: Applications	Bevel and hypoid gears	NVH	Materials in gear production
12:30	Time for Working lunch – meet & greet in the exhibition area, poster presentation area and GearArena				
14:00	Design, application, standardization	Planetary gears: Design	Strength: Bevel, hypoid & worm gears	Manufacturing and operating properties	Modeling and tracing of gear manufacturing processes
15:30	Coffee break – meet & greet at the exhibition area, poster presentation area and GearArena				
16:30	Tooth flank load capacity	NVH: Analysis	Design geometry	Gear geometry and calculation	Gear metrology
18:00	End of the lectures - Switch to the plenary session -				
18:05	Dinner Speech: <b>Dr.-Ing. Bernhard Bouché</b> , Director of Research and Development Mechanics, Getriebbau NORD GmbH & Co. KG, Bargteheide, Germany				
18:45	Organized bus transfer to the evening reception				
19:30	Evening reception at the "Löwenbräukeller" in Munich				

**3rd Conference day**  
Friday, September 15<sup>th</sup>, 2023

	Lecture Room A	Lecture Room B	Lecture Room C	Lecture Room D	Lecture Room E
08:30	Planetary gears: Load distribution	Smart gears	Efficiency and friction	Performance and validation of plastic gears	Sustainability and surface integrity
10:00	Coffee break – meet & greet at the exhibition area, poster presentation area and GearLab				
11:00	Load capacity	NVH	Digitalization of the product development process	Tribology and thermal behavior	Manufacturing processes
12:30	Closing remarks				
12:45	Awarding of the best presentation for young engineers by <b>Prof. Dr.-Ing. Karsten Stahl</b> , Gear Research Center (FZG), TUM School of Engineering and Design, Technical University of Munich, Garching, Germany Awarding of the best paper by <b>Dr.-Ing. Franz Völkel</b> , Sr. Vice President R&D Bearings, Schaeffler Technologies AG & Co. KG, Herzogenaurach, Germany + Lunchtime snack				
14:15	End of the conferences				

# Gears 2023

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

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10:15 -  
12:00



### Keynote session: Re-X: Recycle | Reuse | Reduce

**Moderation: Prof. Dr.-Ing. Karsten Stahl**, (FZG), TUM School of Engineering and Design, Technical University of Munich, Garching, Germany

#### From why to how: It is time for sustainability to move from the executive agenda into the real world

- Determine emission baselines for product portfolio
- Prioritize levers to decrease emissions
- Achieve change through product design and business model adaptation

**Dominik Leisinger, EMBA**, Partner & Europe Lead Product Excellence (PERLab), A. T. Kearney (International) AG, Zurich, Switzerland

#### The need for global standards to define CO<sub>2</sub> footprint in product specifications

- High performance and low emissions is no conflict for engineering steels
- Maximum CO<sub>2</sub> and recycled content as properties in the steel product specifications
- Global initiatives vs. sustainability demands on the product

**Erik Claesson, M. Sc.**, Director, Automotive Segment & Group Business Intelligence, Ovako AB, Hofors, Sweden

#### Refurbishing tracked vehicle transmissions

- Extended lifetime
- Upgrade and RE-use
- Increase share of re-used parts

**Dr.-Ing. Burkhard Pinnekamp**, Head of Central Technology, Sebastian Schießler, M. Eng., Head of Repair, Vehicle Mobility Solutions, RENK GmbH, Augsburg, Germany

#### Increasing air travel and the challenges to reduce emissions

- Future demand in air travel
- Emissions of air travel
- New engine architecture to reduce emission for medium and long range flights

**Dr.-Ing. David Krüger**, Design Engineer, R&T Project Manager, Transmissions, Rolls-Royce Deutschland Ltd & Co. KG, Blankenfelde-Mahlow, Germany

#### Efficiency-improvement with low-loss-gears by two different applications

- Low-loss-gears for a Wolfram-transmission, reduced gear-mesh losses
- Wolfram-transmission without carrier, no losses in the radial bearings for the planets
- Low-loss-gears for a normal planetary transmission (minus-type), efficiency-improvement in a special application

**Prof. i.R. Dr.-Ing. Dr. h.c. Bernd-Robert Höhn**, TUM emeritus of excellence, Michael Geitner, M. Sc., Research Associate, Institute of Machine Elements, Gear Research Center (FZG), TUM School of Engineering and Design, Technical University of Munich, Garching, Germany

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

With digital polls  
during the speeches

### Lecture Room A



#### Tooth root load & carrying capacity

**Moderation:** **Luc Amar, PhD**, CETIM, France/**Dr.-Ing. Rolf Doeberneiner**, AVL List GmbH, Austria

#### 13:30 Optimization of statistical and geometrical evaluation in the determination of tooth root endurance strength

- Influence of asymmetrical clamping of a gear in pulsator tests
- Evaluation of the real geometry of test gears

**Ahmad Alnahlaui, M. Sc.**, Research Assistant, Prof. Dr. Ing. Peter Tenberge, Full Professor, Chair of Industrial and Automotive Drivetrains (IFA), Faculty of Mechanical Engineering, Ruhr-University Bochum, Germany

#### 14:00 The consequences of different methodologies for the elaboration of pulsator test results with respect to the load spectrum assessment of Gears

- Statistical analysis of STBF (Single Tooth Bending Fatigue Test) data
- Effect of the curve shape within the framework of load spectrum assessment

**Luca Bonaiti, M. Sc.**, PhD candidate in Mechanical Engineering, Prof. Ing. Carlo Gorla, Associate Professor, Department of Mechanical Engineering, Politecnico di Milano, Italy; Prof. Dr.-Ing. Karsten Stahl, Full Professor, Institute of Machine Elements, Director, Gear Research Center (FZG), TUM School of Engineering and Design, Technical University of Munich, Garching, Germany

#### 14:30 Tooth bending strain rate analysis in a counter shaft drivetrain and implications on fatigue strengths

- Dynamic tooth bending strain analysis
- Material fatigue strength behaviour under variable strain rate

**Dr. Isaac Hong**, Research Assistant Professor, Dr. David Talbot, Assistant Professor, 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 presentation in the poster exhibition area**

### Lecture Room B



#### NVH: Impacts

**Moderation:** **Dr.-Ing. Bernhard Kohn**, AUDI AG, Germany/**Prof. Dr.-Ing. Jose I. Pedrero**, Universidad Nacional de Educación a Distancia (UNED), Spain

#### Acoustical behavior of periodic flank modifications under dynamic operating conditions

- Acoustic optimisation of gear flank geometry
- Influence of dynamic operating conditions on periodic flank modifications

**Sebastian Sepp, M. Sc.**, Research Associate, Dr.-Ing. Michael Otto, Head of department Calculation and Verification of Transmission Systems, Prof. Dr.-Ing. Karsten Stahl, Full Professor, Institute of Machine Elements, Director, Gear Research Center (FZG), TUM School of Engineering and Design, Technical University of Munich, Garching, Germany

#### The influence of the wheel body design on airborne noise

- Describing how to quickly simulate a wheel body design
- A combination of static and dynamic calculations is used

**Benjamin Abert, M. Sc.**, Head of Consulting and Service, FVA GmbH, Garching; Denis Werner, M. Eng., Calculation and Support Engineer, AVL Deutschland GmbH, Munich, Germany

#### Impact of manufacturing deviations on the NVH behavior of modern gear design concepts

- Deterioration of gear behavior due to manufacturing deviations
- Influence of gear quality on gear mesh characteristics

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

### Lecture Room C



#### Lubrication

**Moderation:** **Prof. Dr.-Ing. Gerhard Poll**, Leibniz University Hannover, Germany/**Prof. Dr. Datong Qin**, Chongqing Jiaotong University, China

#### Lubricant free transmissions for food and beverage applications – a comparison

- Comparison of three different lubricant free transmission technologies
- Magnetic transmissions, porous sintered materials, plastic gears

**Andrej Wallinger, M. Sc.**, Development Engineer, Research & Development, Dr.-Ing. Stefan Vonderschmidt, Managing Director, Dr.-Ing. Reiner Vonderschmidt, Shareholder, Georgii Kobold GmbH & Co. KG, Horb am Neckar, Germany

#### Analysis of load cycles and local wear of dry and solid-lubricated gears

- Analysis of the operational behaviour of dry and solid-lubricated gears
- Analysis of the local wear of the solid lubricant on the tooth flank

**Sebastian Sklenak, M. Eng.**, Research Assistant, Gear Power Density, Prof. Dr.-Ing. Christian Brecher, Full Professor, 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

#### Considerations on lubrication of high-speed rotating gear (first report) – relationship between the lubricating oil behavior and airflow on the tooth surface

- Behavior of the injection oil flow onto the rotating gear tooth surface
- Behavior of airflow generated at the gear engagement

**Kensuke Suzuki**, Development Engineer, Kazuki Sakai, Experiment Sec. Product Development Dept., Kaori Sakai, Product Design Sec. Product Development Dept, UNIVANCE CORPORATION, Kosai-City, Japan



## Lecture Room A



### Damage detection

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

#### 16:00 Investigation of the electrical behavior of a spur gear pair by means of impedance measurements

- Measuring system for determining the electrical properties
  - First results and behaviors of the impedance of a spur gear
- Simon Graf, M. Eng., M. Eng.**, Research Assistant, Dipl.-Ing. Michel Werner, Research Assistant, Jun. Prof. Dr.-Ing. Manuel Oehler; Junior Professor for Mechanical Drive Technology, Chair of Machine Elements, Gears and Tribology (MEGT), Department of Mechanical and Process Engineering, Rheinland-Pfälzische Technische Universität Kaiserslautern-Landau (RPTU), Kaiserslautern, Germany

#### 16:30 Measuring instantaneous angular speed using a gear wheel as material measure to detect pitting damage during an endurance test

- Influence of the transfer path
  - Comparing different measurement systems
- Yanik Koch, M. Sc.**, Research Assistant, Prof. Dr.-Ing. Eckard Kirchner, Director, Institute of Product Development and Machine Elements, Technische Universität Darmstadt; Julian Hirschmann, B. Eng., product engineer vibration analysis, SEW-Eurodrive GmbH, Bruchsal, Germany

#### 17:00 Pitting detection for prognostics and health management in gearbox applications

- Experimental study with predamaged gears
  - AI based damage detection
- Lisa Binanzer, M. Sc.**, Research Assistant, Drive Technology, et. al, Institute of Machine components (IMA), Universität Stuttgart, Germany

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

### Get-together

### 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.

## Lecture Room B



### Asymmetric gear geometry

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

#### Design optimization of multi-stage gear trains with asymmetric teeth under a broad range of torques by incorporating multibody simulations

- Asymmetric gear complex gear train design optimization with a wide range of torques
  - Multibody simulation for accurate gear contact analysis for NVH performance evaluation
- Daehyun Park, PhD**, Senior Research Engineer, Ali Rezayat, PhD, Advanced Research Engineer, Motion Product Development, Siemens Industry Software NV, Leuven, Belgium; Yeohyeon Gwon, M. Sc., Senior Researcher, EV geartrain NVH, Hyundai Motor Company, Gyeonggi-Do, Korea

#### Comparing the contact characteristics of involute gear/eccentric cycloidal gear calculated by various loaded tooth contact analysis models

- Compare results of involute gear from different models
  - Propose a new contact analysis approach for EC gears
- Ling Chiao Chang, M. Sc.**, Research Associate, Dr.-Ing. Shyi-Jeng Tsai, Associate Professor, Department of Mechanical Engineering, National Central University, Taoyuan City, Taiwan; Prof. Dr.-Ing. Karsten Stahl, Full Professor, Institute of Machine Elements, Director, Gear Research Center (FZG), TUM School of Engineering and Design, Technical University of Munich, Garching, Germany

#### Contact simulation of tooth flanks using isogeometric analysis

- Implementation of an isogeometric contact penalty formulation
  - Two-dimensional simulation of contact between mating spur gear teeth
- Dipl. Ing. Christos Karampatzakis**, PhD Candidate, Laboratory of Machine Elements and Machine Design, Aristotle University of Thessaloniki; Prof. Christopher Provatidis, Full Professor, School of Mechanical Engineering, National Technical University of Athens, Greece; Dr. Angelos Mantzaflaris, Research Faculty, Inria Sophia Antipolis, Université Côte d'Azur, Sophia Antipolis, France

## Lecture Room C



### Efficiency and friction

**Moderation:** **Prof. Dr. Eng. Jože Duhovnik**, University of Ljubljana, Slovenia/**Prof. Dr.-Ing. Georg Jacobs**, RWTH Aachen University, Germany

#### Gear friction coefficient estimation using directional parameter under ATF lubricated condition

- Gear frictional properties and the directivities of tooth surfaces
  - Gear friction estimation under ATF lubricated condition
- Junichi Hongu**, Senior Lecturer, Department of Mechanical and Aerospace Engineering, Graduate School of Engineering, Tottori University, Tottori, Japan

#### Frictional behavior in injection lubricated and loss of lubrication conditions: Twin-disc test experiments and simulations

- Friction and lubrication gap during high velocity and high-pressure conditions
  - Influence of topography and loading conditions on time of failure during loss of lubrication
- Dr. mont. Ulrike Cihak-Bayr**, Projectmanager, Key Scientist – Material Simulation, Thomas Wopelka, PhD, Senior Scientist for Nanoscale Wear Analysis, Christoph Wintersteiger, PhD, Junior Scientist, AC2T research GmbH, Wiener Neustadt, Austria

#### Influence of surface and material technologies on loss of lubrication performance of gears

- Friction reduction and scoring prevention of gears facing loss of lubrication
  - Influence of superfinishing and coatings on loss of lubrication behavior
- Bernd Morhard, M. Sc.**, Research Associate, Dr.-Ing. Thomas Lohner, Head of Group EHL-Tribological-Contact and Efficiency, Prof. Dr.-Ing. Karsten Stahl, Full Professor, Institute of Machine Elements, Director, Gear Research Center (FZG), TUM School of Engineering and Design, Technical University of Munich, Garching, Germany

## 2nd Conference day

### Thursday, September 14<sup>th</sup>, 2023

#### Lecture Room A



##### Load capacity

**Moderation: Dr.-Ing. Carsten Gitt**, Mercedes-Benz AG, Germany/**Prof. h.c. Dr.-Ing. Aizoh Kubo**, Research Institute for Applied Sciences, Japan

#### 08:30 Crack growth based tooth root life prediction model

- Crack growth based tooth root lifetime prediction model for very high cycle fatigue
- Analysis of influencing factors on tooth root lifetime

**Johannes Lövenich, M. Sc.**, Research Associate, Moritz Zalfen, M. Sc., Group Leader Gear Power Density, 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

#### 09:00 Experimental investigation of the increased tooth root load capacity of beveloid gears with optimized flank topography

- Test bench to test the tooth root load carrying capacity of beveloid gears
- Tooth root load carrying capacity for beveloids with intersecting axes

**Marius Willecke, M. Sc.**, Research Assistant, Prof. Dr.-Ing. Christian Brecher, Full Professor, Chair of Machine Tools, 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

#### 09:30 Statistical analysis of the influence of inherent manufacturing errors in the mesh load factor in planetary gears

- Application of the Monte Carlo method in the analysis of the planetary gear transmissions performance
- Combination of the effects of different manufacturing errors

**Javier Sanchez-Espiga, PhD**, Assistant Professor, Prof. Dr. Fernando Viadero, Full Professor, Prof. Dr. Alonso Fernandez-del-Rincon, Full Professor, Structural and Mechanical Engineering, University of Cantabria, Santander, Spain

 **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



##### Planetary gears: Simulation and lubrication

**Moderation: Prof. Dr.-Ing. Berthold Schlecht**, Technische Universität Dresden, Germany/**Prof. Dr.-Ing. Michael Weigand**, TU Wien, Austria

#### Simulation study on the tribological characteristics in the meshing contact in the context of the load carrying capacity calculation of internal gears with unbalanced sliding conditions

- Internal gears with unbalanced sliding conditions
- TEHL contact simulation

**Michael Geitner, M. Sc.**, Research Associate, Sebastian Preintner, M. Sc., Research Associate, Dr.-Ing. Thomas Tobie, Head of Department, Load-Capacity Cylindrical Gears, Institute of Machine Elements, Gear Research Center (FZG), TUM School of Engineering and Design, Technical University of Munich, Garching, Germany

#### Thermal model for a planetary gear set using an isothermal approach

- Power losses on a planetary gear train
- Numerical study of oil temperature in a transient regime

**Wassim Ramdane, M. Sc.**, R&D Engineer/PhD Student, Cyril Chevreil--Fraux, PhD, Doctor/Engineer, Machine drives, REDEX Group, Ferrières-en-Gâtinais; Christophe Changenet, PhD, Researcher and Lecturer, Academic Research Department, ECAM La Salle, Lyon, France

#### Wetting and oil flow analysis of planetary gearboxes using oil flow simulations

- Optical validation of simulation data
- Evaluation of fluid flow of 2- & 3-stage planetary gear units
- Analysis of pumping effects of the gearing

**Dr.-Ing. Claus Kunik**, Development Engineer, Dr.-Ing. Jens Kunert, Head of Department, Technology Department Heat Management & Department of Gearing Technology, SEW-EURODRIVE GmbH & Co. KG, Bruchsal, Germany

#### Lecture Room C



##### Efficiency: Gearbox

**Moderation: Prof. Dr.-Ing. Oliver Koch**, Rheinland-Pfälzische Technische Universität Kaiserslautern-Landau (RPTU), Germany/**Dr.-Ing. Bernd Pfeifer**, Magna PT B.V. & Co. KG, Germany

#### On the reduction of windage power losses in gears by the modification of tooth geometry

- Experimental investigation of 3D-printed pinions
- Numerical CFD analysis related to modified tooth geometry

**Dr.-Ing. Michal Ruzek**, Associate Professor, LaMCoS, INSA – Institut National des Sciences Appliquées de Lyon, Villeurbanne Cedex, France; Rémy Brun, B. Sc., master level student, Dr. Yann Marchesse, Associate Professor, ECAM La Salle, Lyon, France

#### Efficient concepts for high ratio angular gearboxes

- Comparison of the ratio-dependent efficiency of different angular gearings
- Introduction of highly efficient W.9 angular gearboxes

**Dr.-Ing. Björn Sievers**, Development Engineer, Dipl.-Ing. (FH). Michael Herberger, Development Engineer, Dipl.-Ing. Felix Rudolph, Development Engineer, SEW-EURODRIVE GmbH & Co. KG, Bruchsal, Germany

#### Holistic sustainability-assessment of gearboxes

- Sustainability evaluation of gearboxes over life cycle
- Assessment of ecological, economic and social aspects

**Prof. Dr.-Ing. Markus Klein**, Professor for machine elements and sustainable product development, Department of mechanical, automotive and aeronautical engineering, University for Applied Sciences Munich, Germany

## Lecture Room A



### Planetary gears: NVH

**Moderation: Prof. Ing. Carlo Gorla**, Politecnico di Milano, Italy/  
**Dr.-Ing. Benedikt Neubauer**, Schaeffler Technologies AG & Co. KG, Germany

#### 11:00 Vibration reduction of planetary gear drive using mesh phasing: modelling and experimental validation

- Conceptual assessment on gears helps improving NVH performance: Gear mesh phasing, suppressing vibrations, operational deflection shapes
- Electric drive unit NVH performance optimization: High speed application, multibody simulation and correlation, evaluation of different planetary designs

**Gowrisankar Devaraj, B. Eng.**, Technical Specialist – Light Vehicle Advanced Engineering, Dana Lindley Technology Centre Ltd, Lindley, UK, Thibault Devreese, M. Sc., Jr Program Manager, Engineering, DANA Incorporated, Belgium

#### 11:30 Influence of axis misalignments in stepped planetary gear stages on the excitation behavior – Test rig development and simulative analysis

- Test rig for investigation of axis misalignments
  - Multi body simulation of misaligned stepped planetary gears
- Christian Westphal, M. Sc.**, Group Leader Gearbox NVH, Research Assistant, Prof. Dr.-Ing. Christian Brecher, Full Professor, Chair of Machine Tools, 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

#### 12:00 Excitation behavior of double helical planetary gear units – Influence of the apex point

- Validation of simulation method by developing and using a back-to-back planetary test rig
  - Evaluation of influence of apex point tolerances on excitation behavior by applying the validated simulation method
- Uwe Weinberger, M. Sc.**, Gear Research Center (FZG), TUM School of Engineering and Design, Technical University of Munich, Garching, 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



### CFD: Applications

**Moderation: Dipl.-Ing. Norbert Haefke**, Research Association for Drive Technology (FVA), Germany/**Prof. Daisuke Iba**, Kyoto Institute of Technology, Japan

#### Challenges and possibilities of virtual development of transmission systems

- Optimization of oil flow in early design stages
  - Prediction of torque losses due to oil splashing
- Michael Reichl, M. Sc.**, Senior Simulation Engineer, Philipp Lenz, M. Sc, Simulation Engineer, AVL Deutschland GmbH, Munich, Germany

#### Latest advancements in the lubrication simulations of geared systems: a technology ready for industrial applications

- Lubrication simulations of gearboxes
  - Latest modelling approaches with high computational efficiency
- Prof. Dr.-Ing. Franco Concli, PhD**, Professor of Machine Design, Head of the Materials Characterization Lab, Faculty of Engineering, Free University of Bozen, Italy

#### Lubrication improvement at the HS-IS spline shaft interface of a wind turbine gearbox using the smooth particle hydrodynamic method

- Improved understanding of local oil flows using advanced computational methods
  - Local design optimization allows to utilize superior designs by removing local shortcomings
- Dr.-Ing. Moritz Oliver Gebhardt**, Senior Manager Data Analysis, Dr.-Ing. Alexander Rhode, Head of Engineering Wind, NGC Transmission Europe GmbH, Duisburg, Dipl.-Ing. Benjamin Legrady, Customer Success Lead, dive solutions GmbH, Berlin, Germany

## Lecture Room C



### Bevel and hypoid gears

**Moderation: Prof. Dr.-Ing. Aleksandar Miltenović**, University of Niš, Serbia/**Dipl.-Ing. Zsolt Roth**, J. M. Voith SE & Co. KG | VTA, Germany

#### The relevance of pinion deflection and twisting for loaded tooth contact analysis of high reduction hypoid gears

- FEA simulations of contact of high reduction hypoid gears
  - Influence of twist and bending on the contact pattern of HRHs
- Dipl.-Ing. Wolf Wagner**, Research Associate, Dr.-Ing. Stefan Schumann, Chief Engineer, Prof. Dr.-Ing. Berthold Schlecht, Full Professor and Head of Institute of Machine Elements and Machine Design, Faculty of Mechanical Science and Engineering, Technische Universität Dresden, Germany

#### The effect of pinion axial positioning on noise and transmission error of face hobbed and face milled bevel gears

- Results of an experimental campaign performed on bevel gears
  - Particular considerations are made with respect to the effect of misalignments
- Luca Bonaiti, M. Sc.**, PhD candidate in Mechanical Engineering, Prof. Dr.-Ing. Paolo Chiariotti, Department of Mechanical Engineering, Prof. Ing. Carlo Gorla, Associate Professor, Department of Mechanical Engineering, Politecnico di Milano, Italy

#### Exploration of trade-offs between NVH and efficiency in bevel gear design

- Efficiency and NVH optimization
  - Pareto front exploration
- Eugeniu Grabovic, PhD**, Assistant Professor, Prof. Ing. Alessio Artoni PhD, Associate Professor, Prof. Ing. Marco Gabiccini PhD, Associate Professor, Department Civil and Industrial Engineering, Università di Pisa, Italy



## Lecture Room A



### Design, application, standardization

**Moderation:** Eng. Amir Aboutaleb, American Gear Manufacturers Association, USA/**Prof. Dr.-Ing. Dr. h. c. Albert Albers**, Karlsruhe Institute of Technology (KIT), Germany

#### 14:00 Review of different calculation approaches for the mean coefficient of friction in ISO 6336

- Analysis of approaches due to origin and validated ranges
- Exemplary comparative calculations for various applications

**Niklas Blech, M. Sc.**, Research Associate, Dr.-Ing. Thomas Tobie, Head of Department, Load-Capacity Cylindrical Gears, Prof. Dr.-Ing. Karsten Stahl, Full Professor, Institute of Machine Elements, Director, Gear Research Center (FZG), TUM School of Engineering and Design, Technical University of Munich, Garching, Germany

#### 14:30 Forward performance-driven design of gear parameters

- Multi-objective optimization design of gear parameters
- Universal design method of symmetric and asymmetric gears

**Shuxin Chen**, Master Student, Prof. Changzhao Liu, PhD, Associate Professor, Prof. Datong Qin, PhD, Professor, State Key Laboratory of Mechanical Transmissions, Chongqing University, China

#### 15:00 Analysis of quasi-static mesh characteristics of gear transmission considering system deformation

- LTCA method considering system deformation
- Coupling characteristics of multi-gearbox system

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



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

**15:45 - 16:00** Poster presentations in the poster exhibition area

## Lecture Room B



### Planetary gears: Design

**Moderation:** Prof. i.R. Dr.-Ing. Dr. h.c. Bernd-Robert Höhn, TUM emeritus of excellence, Technical University of Munich, Germany/**Prof. Wenzhong Wang**, Beijing Institute of Technology, China

#### Design and analysis of compound stepped planetary gear drives for better transmission performances

- Design rules for compound stepped planetary gear sets
- Effects of meshing-phase on transmission performances by LTCA

**Ling Chiao Chang, M. Sc.**, PhD Candidate, Dr.-Ing. Shyi-Jeng Tsai, Associate Professor, Qi-You Zhuang M. Sc., PhD Candidate, Department of Mechanical Engineering, National Central University Taiwan, Taoyuan City, Taiwan

#### Evaluation of the effect of the rim thickness on the root stress cycle of helical planet gears with integrated rollers

- Stress analyses of planet-sun and planet-ring models
- Finite element modelling considering the rollers rigidity

**Dr. Ignacio Gonzalez-Perez**, Full Professor, Department of Mechanical Engineering, Materials and Manufacturing, Universidad Politecnica de Cartagena, Spain; Alfonso Fuentes-Aznar, Professor, Rochester Institute of Technology, Rochester NY, USA; Jose Calvo-Irisarri, Engineer, Gamesa Energy Transmission S. A., Zamudio, Spain

#### Experimental investigation of moving contact pattern in planetary gearboxes

- Impact of shaft misalignments on the contact pattern, depending on the carrier rotational position
- Tooth root strain and coordinate measurements

**Marius Fürst, M. Sc.**, Research Associate, Institute of Machine Elements, Gear Research Center (FZG), TUM School of Engineering and Design, Technical University of Munich, Garching, Germany

## Lecture Room C



### Strength: Bevel, hypoid & worm gears

**Moderation:** Prof. Dr.-Ing. Athanassios Mihailidis, former Aristotle University of Thessaloniki, Greece/**Prof. Dr.-Ing. Michael Weigand**, TU Wien, Austria

#### Transferability of the scuffing load capacity of gear oils determined on spur gears to hypoid gears

- Comparison of test methods
- Transferability of test results from spur to hypoid gears

**Alexander Drechsel, M. Sc.**, Team Leader Bevel Gears and Lean Management, Dr.-Ing. Josef Pellkofer, Head of Department of Worm gears and Bevel gears, Fatigue life analysis, Prof. Dr.-Ing. Karsten Stahl, Full Professor, Institute of Machine Elements, Director, Gear Research Center (FZG), TUM School of Engineering and Design, Technical University of Munich, Garching, Germany

#### Fatigue testing of large sized bevel gears

- Novel testing setup capable of fatigue tests with high power and large gears
  - Proven capability to produce TFF failures in testing environment
- Erkka Virtanen, M. Sc.** (Tech), Doctoral researcher/PhD Student, Mikko Kanerva, Associate Professor, Faculty of Engineering and Natural Sciences, unit of Material Sciences, research group of Tribology and Machine Elements, Faculty of Engineering and Natural Sciences, Tampere University; Gabor Szanti, M.Sc. (Tech), Engineering and Development Manager, ATA Gears Oy, Tampere, Finland

#### Calculation method for wear of steel-bronze rolling-sliding contacts relating to worm gears

- Wear behavior of steel-bronze rolling-sliding contacts
- Wear calculation of steel-bronze pairings

**Dipl.-Ing. (FH) Philipp Schnetzer, M. Sc.**, Research Associate, Dr.-Ing. Josef Pellkofer, Head of Department of Worm gears and Bevel gears, Fatigue life analysis, Prof. Dr.-Ing. Karsten Stahl, Full Professor, Institute of Machine Elements, Director, Gear Research Center (FZG), TUM School of Engineering and Design, Technical University of Munich, Garching, Germany

## Lecture Room A



### Tooth flank load capacity

**Moderation:** Dr.-Ing. Bernhard Bouché, Getriebbau NORD GmbH & Co. KG, Germany/Prof. Bingkui Chen, Chongqing University, China

#### 16:30 Scuffing load carrying capacity of high-speed gears with an isotropic superfinished surface

- Scuffing load carrying capacity of high speed gears
- Improved method to calculate scuffing

**Jaacob Vorgerd, M. Sc.**, Research Assistant, Prof. Dr.-Ing Peter Tenberge, Full Professor, Chair of Industrial and Automotive Drivetrains (IFA), Faculty of Mechanical Engineering, Ruhr-University Bochum, Germany

#### 17:00 On the testing of flank fracture calculations based on 3D-gears

- Calculation of flank fracture damage with different approaches
- Application of the calculation approaches on three dimensional gears

**Dipl.-Ing. Thi Tra My Truong**, Research Associate, Dr.-Ing. Stefan Schumann, Chief Engineer, Prof. Dr.-Ing. Berthold Schlecht, Full Professor and Head of Institute of Machine Elements and Machine Design, Faculty of Mechanical Science and Engineering, Technische Universität Dresden, Germany

#### 17:30 White Etching Cracks (WECs) on gears of E-Axle applications

- Premature tooth flank fatigue due to WECs
- Testing of oils concerning WEC-potential

**Dipl.-Ing. (FH) Thomas Schmidt**, Senior Specialist, Gears, Dr.-Ing. Benedikt Neubauer, Director Gears e-mobility, Schaeffler Technologies AG & Co. KG, Herzogenaurach; Dipl.-Ing. Daniel Merk, Senior Expert Bearing Technology, Validation Industrial, Schaeffler Technologies AG & Co. KG, Schweinfurt, Germany

#### 18:00 End of the lectures

- Switch to the plenary session-

#### 18:05 Dinner speech

**What is the taste of gears like?**

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

#### 18:45 Organized bus transfer to the evening reception

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

#### 19:30 Evening reception at the "Löwenbräukeller" in Munich

## Lecture Room B



### NVH: Analysis

**Moderation:** Dr.-Ing. Alex Kapelevich, AKGears, LLC, USA/Dr.-Ing. Andreas Klein, Flender GmbH - Winergy Voerde, Germany

#### A comparison of time and frequency domain approaches for NVH

- Calculation approaches and major setting parameters
- Comparison of results regarding amplitudes and frequencies

**Dipl.-Ing. Jürg Langhart**, Senior Engineer - Global Sales, Prof. Dr.-Ing. Saeed Ebrahimi, Software Developer, KISSsoft AG, Bubikon, Switzerland; Dipl.-Ing. Thomas Kelichhaus, General Manager, FunctionBay GmbH, Munich, Germany

#### Investigation of sound and vibration behavior of cylindrical gears

- Nonlinear frequency response analysis
- Determination of equivalent radiated power

**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

#### Validation of an industrial gearbox model for predicting vibro-acoustic behavior

- Systematic experimental validation of the dynamics of an industrial gear unit
- The MBS model considers the measured gear flanks and profiles

**Prateek Chavan, M. Sc.**, Development Engineer, Simulation Gear Units, Dipl.-Ing. Markus Lutz, Head of Department, SEW-EURODRIVE GmbH & Co. KG, Bruchsal, Germany

## Lecture Room C



### Design geometry

**Moderation:** Dr.-Ing. Johannes König, ZF Friedrichshafen AG, Germany/Dr.-Ing. Kai Lubenow, Eickhoff Antriebstechnik GmbH, Germany

#### Local load capacity analysis for the design of a balanced flank modification for cylindrical gears according to bevel gear procedures

- Influence using Weber-Banaschek, BEM and FEA for the calculation of load distribution and load capacity for cylindrical gears
- Influence of the interaction of cylindrical gears and the overall system on the load distribution

**Dipl.-Ing. Frederik Mieth**, Software development engineer, Modeling and Simulation, Dipl.-Ing. Dennis Tazir, Software development engineer, FVA GmbH, Frankfurt am Main, Germany

#### Analysis of new tooth profile design based on the biomimetics principles

- The idea for profile design inspired by nature is presented
- Procedure based on FEA and TCD is explained and implemented

**Dr. Ivana Atanasovska**, Research Professor, Mathematical Institute of the Serbian Academy of Sciences and Arts (Mathematical Institute SANU), Department of Mechanics; Dr. Dejan Momcilovic, Assistant Research Professor, Institute for material testing IMS, Belgrade, Serbia

#### Study on the tip interference in low gear ratio internal spur gears with profile modification

- A discussion on the influence of the depth of relief on the tip interference in internal gears
- A new methodology to combine modifications of center distance, teeth height, rack shift coefficients and tip relief depths to maximize the contact ratio

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



## 3rd Conference day

Friday, September 15<sup>th</sup>, 2023

### Lecture Room A



#### Planetary gears: Load distribution

**Moderation: Prof. Dr.-Ing. Manfred Hirt**, Past President, Research Association for Drive Technology (FVA), former board of Renk GmbH, Germany/**Prof. Ahmet Kahraman**, The Ohio State University, Columbus, USA

#### 08:30 Parametric system simulation of load sharing in planet stages

- FE simulation of contact behavior in planetary stages to analyse load sharing
- Influence of stiffness of structural components and of misalignments on load sharing

**Dipl.-Ing. Jean-André Meis**, Head of Technology and Materials, Technology & Innovation, Flender GmbH, Bocholt, Germany

#### 09:00 Mesh load factor in multiple planetary stage gearboxes

- System understanding of a gearbox with 3 planetary stages
- Interaction of planetary stages and those impact on mesh load factor

**Abdul Baseer, M. Eng.**, Simulation Engineer, Dr.-Ing. Björn Bauer, Head of Gearbox Development, Cong Wang, M. Eng., General Manager, DHHI Germany GmbH, Bochum, Germany

#### 09:30 Assessing gear mesh misalignment in a helical gear set by transmission error measurements

- Indirect gear flank load distribution assessment
- Gear transmission error versus flank load distribution

**Nico De Bie, M. Sc.**, Gear Technology Engineer, Wim Smet, B. Sc., Gear Expert Engineer, Product Technology, Business Unit Wind Power Technology, Tom Van Der Kamp, B. Sc., Test Engineer, NVH & Loads, ZF Wind Power, Lommel, Belgium

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

### Lecture Room B



#### Smart gears

**Moderation: Prof. Dr.-Ing. Oliver Koch**, Rheinland-Pfälzische Technische Universität Kaiserslautern-Landau (RPTU), Germany/**Prof. Dr. Geng Liu**, Northwestern Polytechnical University; Shaanxi Engineering Laboratory for Transmissions and Controls, China

#### Helicopter drive system safety dissertation

- Helicopter gearbox failure detection system design & testing
- Loss of lubricant conditions: design & testing phase

**Sergio Sartori, Eng.**, Head of Analysis & Innovation, Transmission Systems Design & Development, Leonardo SpA, Samarate, Italy

#### Smart gearboxes for a sustainable and reliable industry

- Smart gearbox as a multichannel sensor within the drive train
- Process optimization using knowledge of real load conditions

**Dennis Meyering, M. Eng.**, Data Scientist, Carsten Hussmann, M. Eng., Data Scientist, Digital Business – Data Analytics and Operations, Flender GmbH, Voerde, Germany

#### High ratio gearbox with very low bearing loads

- Smart gear system for health monitoring
- Wireless health monitoring during operation

**Dr. Daisuke Iba**, Professor, Department of Mechanical Engineering, Kyoto Institute of Technology, Kyoto, Japan

### Lecture Room C



#### Efficiency & friction

**Moderation: Dr.-Ing. Ralf Möllendorf**, Flender GmbH, Germany/**Dr.-Ing. Toni Weiss**, Gear Consultant, ret. from RENK GmbH, now GanaCon – Gear analysis and Consulting, Germany

#### Simulation-based optimization of gearing efficiency using DLC coatings

- Potential of tooth flank coatings for friction reduction
- Impact of thermo-physical properties of a coating

**Dipl.-Ing. Ronny Beilicke**, Project Engineer, Prof. Dr.-Ing. Dirk Bartel, CEO, Dr.-Ing. Lars Bobach, Software Developer, Tribo Technologies GmbH, Magdeburg, Germany

#### Gearbox efficiency of eDrives: Correlation between measurement and calculation of load-dependent torque losses

- Calculation of gearbox efficiency
- Correlation between measurement and calculation

**Dr.-Ing. Mustafa Yilmaz**, Development Engineer Gear Design, Gear Development, ZF Friedrichshafen AG, Friedrichshafen, Germany

#### Modifying gear surface to achieve higher efficiency

- Modifying gear surface by superfinishing and coating
- Quantifying efficiency gains by surface engineering

**Jishan Zhang, PhD**, Senior Test Engineer, Design Unit, School of Engineering, Newcastle University, Newcastle upon Tyne, United Kingdom

## Lecture Room A



### Load capacity

**Moderation: Prof. Dr.-Ing. Karsten Stahl**, Technical University of Munich, Garching, Germany

- 11:00 **Review of the definition of the loads for spur and helical gears in standards and handbooks**
  - Gear load definition
  - Teaching exercise

**Luc Amar, PhD**, Research Engineer, Power Transmissions (TDP), CETIM (Technical Center for Mechanical Engineering Industries), Senlis Cedex, France; **Dr.-Ing. Ulrich Kissling**, President, KISSsoft AG, Bubikon, Switzerland
- 11:30 **Hybrid models for the simulation of displacements and stresses in light-weight gears**
  - Model showing displacement and stress within the gear body
  - Interaction between body stress and dynamic mesh force

**Dr.-Ing. Bérengère Guilbert**, Associate Professor, Prof. David Dureisseix, Full Professor, Prof. Dr.-Ing. Philippe Velex, Full Professor, LaMCoS, INSA – Institut National des Sciences Appliquées de Lyon, Villeurbanne Cédex, France
- 12:00 **Development of damage-based accelerated life test code for gearbox using genetic algorithm**
  - Methodology for mechanical component life test estimation
  - Guarantee the mechanical components life within short period of time

**Jung-Ho Park**, PhD Student, Biosystems engineering, Seoul National University, Seoul, Republic of Korea

■ 12:30 **Closing remarks**



■ 12:45 **Awarding of the best presentation for junior engineers by Prof. Dr.-Ing. Karsten Stahl**, Gear Research Center (FZG), TUM School of Engineering and Design, Technical University of Munich, Garching, Germany

### Awarding of the best paper by

**Dr.-Ing. Franz Völkel**, Sr. Vice President R&D Bearings, Schaeffler Technologies AG & Co. KG, Herzogenaurach, German

+ Lunchtime snack



■ 14:15 **End of the conference**

## Lecture Room B



### NVH

**Moderation: Dr.-Ing. Bernhard Bouché**, Getriebbau NORD GmbH & Co. KG, Germany

- **Electromechanical coupling modeling and torsional vibration analysis of helicopter electric propulsion system**
  - Electromechanical model of electric propulsion system
  - Prediction and suppression of torsional vibration

**Hanjie Jia, PhD**, Lecturer, Datong Qin, PhD, Professor, Guanghong Hu, Master Student, Xiangyang Xu, PhD, Professor, Chongqing Jiaotong University, China
- **Numerical analysis of bevel gear transmission acoustic emission using a 3D gear contact force model within a multibody system dynamic simulation**
  - Accurate 3D gear contact analysis of spiral bevel gears using flexible multibody simulation
  - Vibro-acoustic performance simulation of bevel geared drivetrains

**Dr. Mathijs Vivet**, Research Engineering Manager, Product Development – Simulation 3D Mechanical, Siemens Digital Industries Software, Leuven, Belgium
- **Experimental investigation of influence of spacing errors on gear rattling**
  - Vibro-impacts of gearshaving spacing errors under lightly loaded operating conditions
  - Gear set-up with external torque fluctuation capabilities and associated instrumentation

**Prof. Ahmet Kahraman**, Professor and Director, Dr. Ata, Donmez, Postdoctoral Researcher, Gear and Power Transmission Research Laboratory, Department of Mechanical and Aerospace Engineering, The Ohio State University, Columbus, Ohio, USA

## Lecture Room C



### Digitalization of the product development process

**Moderation: Dr.-Ing. Burkhard Pinnekamp**, RENK GmbH, Germany

- **Digitalization of the gear development process – Chances, benefits and risks**
  - Data exchange during the complete product development cycle
  - Integration of digital twin models and services into Catena-X

**Dr.-Ing. Johannes König**, Manager Gear Fundamentals & Digitalization, Dr.-Ing. Martin Obermayr, Manager CoE Digital Twin, Tobias Klein M. Sc., R&D Engineer, ZF Friedrichshafen AG, Friedrichshafen, Germany
- **Opportunities arising from digital twins in gear development**
  - Photogrammetric mapping of 2D photo data onto a virtual 3D gear
  - Automatic correction of the contact pattern for bevel gears

**Dipl.-Ing. Constantin van Oss**, Research Associate, Dr.-Ing. Stefan Schumann, Chief Engineer, Prof. Dr.-Ing. Berthold Schlecht, Full Professor and Head of Institute of Machine Elements and Machine Design, Faculty of Mechanical Science and Engineering, Technische Universität Dresden, Germany
- **The impact of different reliability data on a cloud-based gearbox digital twin using telematic data**
  - Set up of a cloud-based digital twin using telematic data from vehicles
  - Interpretation of different reliability data in this digital twin and implications

**MA MEng CEng MIMechE, Barry James**, Senior Technical Leader, Research and Innovation, Romax Technology, Ltd., Nottingham, United Kingdom; **Dipl.-Ing. (FH) Detlev Runkel**, Senior Solutions Strategist, Hexagon Applied Solutions Group, Garching, Germany

## Location/Venue



The Gear Research Center (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 2023

Technical University of Munich  
TUM School of Engineering and Design  
Institute of Machine Elements  
**Gear Research Center (FZG)**  
Boltzmannstr. 15  
85748 Garching, Germany

### How to find us

Find all travel information at a glance!  
[www.mec.ed.tum.de/en/fzg/contact-and-directions/fzg/](http://www.mec.ed.tum.de/en/fzg/contact-and-directions/fzg/)



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Source: Andreas Heddergott/TUM

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## Poster Exhibition

Combined with  
5-minute talks!

### P1 Modelling and analysis of the effect of root modification on load sharing and stress values in spur gears

**Ali Imre Aydeniz, PhD**, Mechanical Engineering, Istanbul Technical University (ITU), Istanbul, Turkey

### P2 LUBGEAR – Experimental Campaign for Aviation Gears in Loss-of-Lubrication

**Dipl.-Ing. Lorenz Braumann**, Research Engineer, Advanced Drivetrain Technologies GmbH, Vienna, Austria

### P3 PVD deposition of Nb-MoS<sub>2</sub> coatings on gear carburized steel

**Angelo Carvalho, M. Sc.**, Research Assistant, Competence Center in Manufacturing, Aeronautics Institute of Technology, São José dos Campos, Brazil

### P4 Testing and modelling of a 2.5 MW wind turbine gearbox: Influence of lubricant formulation

**Carlos Fernandes, PhD**, Assistant Professor, INEGI – Institute of Science and Innovation in Mechanical and Industrial Engineering, Porto, Portugal

### P5 Improvement of the transmission efficiency in electric vehicles by using double staggered helical gears

**Dr. Ignacio Gonzalez-Perez**, Full Professor, Department of Mechanical Engineering, Materials and Manufacturing, Universidad Politecnica de Cartagena, Spain

### P6 Method for calculating the tooth root nominal stress in worm gear shafts

**Johannes Gründer, M. Sc.**, Research Assistant, Institute for Chemical-, Material- and Product Development, Nuremberg Institute of Technology, Germany

### P7 Developing CAE solutions for robotics gears; Cycloidal and Strain Wave Gear Drives. Leveraging more mature robust technologies from the automotive industry

**Owen Harris, PhD**, Research Department Manager, Research, Smart Manufacturing Technology, Nottingham, United Kingdom

### P8 The effect of working surface deviation on transmission error in helical gear

**Dongu Im**, Student/PhD candidate, Researcher, Department of Biosystems Engineering, Design of Off-Road Equipment and Soil-Machine Systems, College of Agriculture and Life Sciences, Seoul National University, Korea

### P9 A study on the efficiency prediction of a gear bearing drive by means of mathematical modelling

**Bahadır Karba**, PhD candidate, Transmission & Powertrain Design Engineer Lvl III., Research & Development, TR Transmisyon engineering Inc., Ankara, Turkey

### P10 Backlash optimization via compatible gear couples on the assembly lines for planetary gearboxes

**Bahadır Karba**, PhD candidate, Transmission & Powertrain Design Engineer Lvl III., Research & Development, TR Transmisyon engineering Inc., Ankara, Turkey

### P11 Classifying plastic beveloid gear quality considering manufacturing errors

**Bahadır Karba**, PhD candidate, Transmission & Powertrain Design Engineer Lvl III., Research & Development, TR Transmisyon engineering Inc., Ankara, Turkey

### P12 Investigation of the electrical impedance of the gear mesh of a spur gear in an industrial gearbox

**Prof. Dr.-Ing. Eckard Kirchner**, Director, Institute of Product Development and Machine Elements, Technische Universität Darmstadt, Germany

### P13 Development of optimal design program for planetary gear set macro-geometry using multi-objective optimization algorithm

**Beom-Soo Kim**, Lab. for Off-Road Equipment and Soil-Machine Systems Design, Department of Biosystems Engineering, Seoul National University, Seoul, Korea

### P14 Test rig trials on transmissions for lubricant aging and analysis of the properties of used lubricants

**Timo König, M. Eng.**, Research Assistant, Institute for Drive Technology Aalen, Hochschule Aalen – Technik und Wirtschaft, Germany

### P15 Parameter based definition of eccentric cycloid gearings

**Stefan Landler, M. Sc.**, Research Associate, Institute of Machine Elements, Gear Research Center (FZG), TUM School of Engineering and Design, Technical University of Munich, Garching, Germany

### P16 Model based NVH design: E-bike application

**Dr.-Ing. Herve Mahe**, NVH Master Expert, NVH discipline manager, New Mobility Center, Valeo Transmissions, Amiens, France

### P17 Effect of overlap ratio on gear dynamic behavior and noise level

**Joao Marafona, M. Eng.**, PhD Student, Tribology, Vibrations and Industrial Management Unit, INEGI – Institute of Science and Innovation in Mechanical and Industrial Engineering, Porto, Portugal

### P18 Overview of gear mesh and bearing frequencies and their application in a heavy-duty industrial gearbox condition monitoring

**Sebastjan Matkovič, M. Eng.**, Developer & Researcher, KISSsoft AG, Bubikon, Switzerland

### P19 Influence of misalignment of large cylindrical gears on contact pattern in operation

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

### P20 Gear geometry, size and material influences not captured in ISO 6336

**Wim Smet, B. Sc.**, Gear Technology, ZF Wind Power Antwerpen N.V., The Netherlands

### P21 Numerical simulation of low-temperature lubrication in gear models using MPS method

**Chunhui Wei**, PhD Student, School of Mechanical Engineering, Beijing Institute of Technology, China and INSA – Institut National des Sciences Appliquées de Lyon, Villeurbanne Cédex, France

### P22 Three-dimensional dynamic contact behaviors of gear pairs with various tooth flank errors

**Dr. Bing Yuan**, Professor, Xi'an Technological University, China

### P23 Meshing limit line of offsetting ZC1 worm drive

**Prof. Dr. Yaping Zhao**, College of Mechanical Engineering and Automation, Northeastern University China, Shenyang City, China

### P24 A novel dynamic modeling method of high-speed thin-rimmed gear transmission

**Jiayu Zheng, M. Sc.**, PhD student, State Key Laboratory of Mechanical Transmissions, Chongqing University, China

Free of charge  
for participants of the "International  
Conference on Gears 2023"



## 5th International Conference on Gear Production 2023

September 13 - 15, 2023, Garching/Munich, Germany



Source: © WZL, RWTH Aachen/Ahmad

### Key topics:

- Sustainable gear production
- Inline quality inspection for gear production
- Additive manufacturing of gears
- Performance of new gear materials in gear manufacturing
- Hard finishing of high performance gears
- Innovative processes for gear manufacturing

### 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

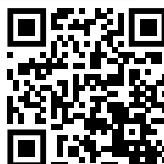
**Prof. Dr.-Ing. Christian Brecher**, Full Professor, Chair of Machine Tools, Laboratory for Machine Tools and Production Engineering (WZL), Faculty for Mechanical Engineering, RWTH Aachen University, Germany

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

### The conference will give you the answers to these questions:

- How do we manufacture high performance gears in the future?
- What are best practices for the additive manufacturing of gears?
- How do we increase sustainability in gear manufacturing?
- Which digital solutions drive gear production?
- What are the innovations in gear metrology?

Further details and the final program can be found here:  
[www.vdicongference.com/02TA411023](http://www.vdicongference.com/02TA411023)



## 5th International Conference on High Performance Plastic Gears 2023

September 13 - 15, 2023, Garching/Munich, Germany



Source: © HORST SCHOLZ GmbH & Co. KG

### Key topics:

- Carbon footprint assessment of sustainable plastic materials
- Influence of manufacturing on gear quality and load capacity
- Recent calculation methods for load capacity and excitation behavior
- Recent test methods of plastic gears
- Optimizations of plastic gears

### Presidency:

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

### Conference Board:

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

**Ingo Decker, M. Eng.**, Gear Development, Group Wide Components, Corporate Research & 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

### The conference will give you the answers to these questions:

- How can the carbon footprint of plastic gears be assessed and optimized?
- How can plastic gears be recycled?
- How can lubrication improve the performance of plastic gears?
- How can the NVH-behavior of plastic gears be evaluated and optimized?
- How does the manufacturing process impact gear performance and cost?

Further details and the final program can be found here:  
[www.vdicongference.com/02TA409023](http://www.vdicongference.com/02TA409023)





## 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 Center (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 meetup

### 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 'Löwenbräukeller' as well as another social event at the university. The 'Löwenbräukeller' is a restaurant with a long tradition offering modern Bavarian cuisine.

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: Löwenbräukeller Archiv

## Presidency



### Conference President

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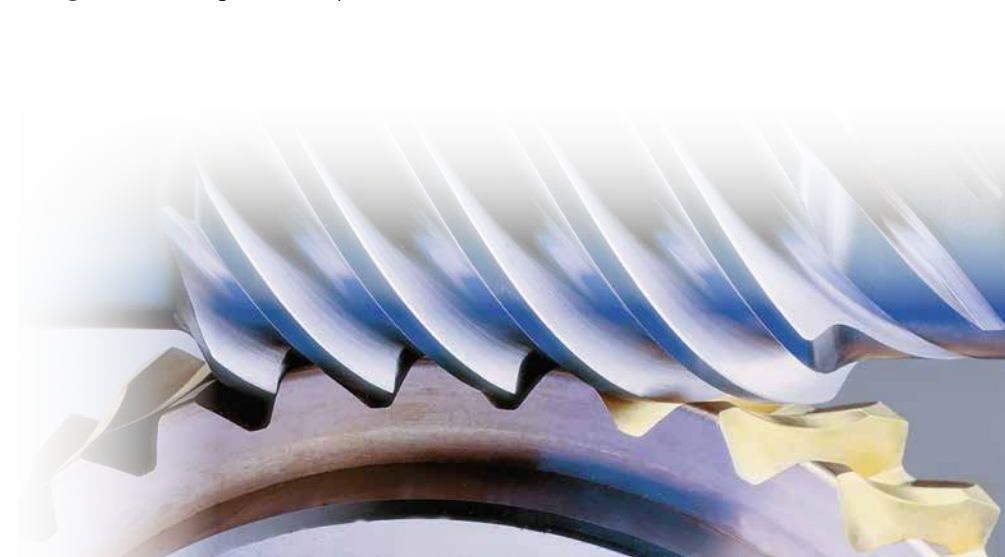
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