

# International Conference on Gears 2019

FZG, Garching/Munich, Germany

#VDI\_Gears

Source: Getriebbau NORD GmbH & Co. KG

## Key topics:

- Optimization of gear design and geometry
- System-modelling, -simulation and -calculation of gears
- New calculation methods for load carrying capacity, strength and more efficiency
- NVH behavior and noise reduction of transmission systems
- Condition monitoring and damage detection
- Lubrication and TEHL

## Gears interactive

GearLab  
Speakers meet up  
FZG lab tours  
Poster exhibition with  
impulse talks  
Two gear community nights

## Associated organisations:



American Gear  
Manufacturers, USA



ARTEMA, France



ASSIOT, Italy



BAPT



British Gear  
Association



Chinese Mechanical  
Engineering Society



Canadian Society for  
Mechanical Engineering



Drive Technology Research  
Association, Germany



Gear Research Institute, USA



Scientific Society of Mechanical  
Engineers, Hungary



Institution of Mechanical  
Engineers, United Kingdom



Japan Society of  
Mechanical Engineers



Koninklijk Instituut van Ingenieurs,  
The Netherlands



The Korean Society of Mechanical  
Engineers, Korea



Romanian Association of  
Mechanical Transmissions



WiGeP, Germany

## Visit parallel conferences free of charge



**Gear Production 2019**  
[www.vdi-wissensforum.de/gearproduction](http://www.vdi-wissensforum.de/gearproduction)



**High Performance Plastic Gears 2019**  
[www.vdi-wissensforum.de/plasticgears](http://www.vdi-wissensforum.de/plasticgears)

An event organized by VDI Wissensforum  
[www.vdi-gears.eu](http://www.vdi-gears.eu)

## 1st Conference day Wednesday, September 18<sup>th</sup>, 2019

08:30 Registration

### Plenary session

09:30 **Common welcome and opening of the**

- International Conference on Gears 2019
- International Conference on High Performance Plastic Gears 2019
- International Conference on Gear Production 2019

**Prof. Dr.-Ing. Karsten Stahl**, FZG, Technische Universität München (TUM), Garching, Germany

09:45 **Welcome address by**

**Matthew E. Croson**, President, American Gear Manufacturers Association (AGMA), Alexandria, USA &  
**Dr.-Ing. Arbogast M. Grunau**, FVA, Frankfurt a. M. & Schaeffler Technologies AG & Co. KG, Herzogenaurach, Germany



10:00 **Keynote session: From system to atom – digital twins on all scales?**

**Looking into small scale drives driving technology**

**Dr.-Ing. Arbogast M. Grunau**, FVA, Frankfurt a. M. & Schaeffler Technologies AG & Co. KG, Herzogenaurach, Germany

**Challenges in modeling multi-scale physics in gear contact problems**

**Prof. Ahmet Kahraman**, The Ohio State University, Columbus, USA

**Atomistic simulations in tribology: potentials, perspectives and limitations**

**Dr. Gianpietro Moras**, Fraunhofer Institute for Mechanics of Materials IWM, Freiburg, Germany

11:45 **Time for a working lunch** – meet & greet at the exhibition area, poster presentation area and GearLab

With digital polls during the speeches

### Parallel sessions

#### International Conference on Gears

Lecture Room A

Lecture Room B

Lecture Room C

13:15 **Flank strength**

**NVH**

**Efficiency**

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

16:00 **Tooth root strength**

**Loaded tooth contact analysis**

**Condition monitoring**

18:15 Organized bus transfer to the evening reception



19:00 **Evening reception at Paulaner am Nockherberg**

**Dinner Speech: Dr.-Ing. E. h. Manfred Wittenstein**, Chairman of the Supervisory Board, WITTENSTEIN SE Igersheim, Germany

#### Parallel conferences - Free of charge -

**International Conference on Plastic Gears**

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

Lecture Room D

**Insight into the world of plastic gears/Strength evaluation**

**Tooth flank load capacity**

**International Conference on Gear Production**

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

Lecture Room E

**Industry 4.0**

**Measurement technology**

# Program overview

International Conference on Gears and parallel conferences

## 2<sup>nd</sup> Conference day

Thursday, September 19<sup>th</sup>, 2019

	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	Strength	Transmission error	Bevel and hypoid design and manufacturing	Strength evaluation	Gear soft machining
10:00	Coffee break – meet & greet at the exhibition area, poster presentation area and GearLab				
10:45	Geometry, quality	Dynamic	Bevel and hypoid endurance	Strength evaluation	Gear skiving
12:45	Time for a working lunch – meet & greet at the exhibition area, poster presentation area and GearLab				
14:15	Lubrication, EHL	Worm and crossed axis helical gears	Bevel and hypoid transmission error	NVH/condition monitoring	Bevel gear production
15:45	Coffee break – meet & greet at the exhibition area, poster presentation area and GearLab				
16:30	Lubrication, flank strength	Calculation/standard	Dynamics and planetary gears	Application	Gear honing & grinding
18:30	<b>Evening reception at the conference venue</b> <b>Dinner Speech: Prof. Dr. Changle Xiang</b> , Professor, Vice President, Beijing Institute of Technology, Director, National Key Lab of Vehicle Transmission, China				

## 3<sup>rd</sup> Conference day

Friday, September 20<sup>th</sup>, 2019

	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	Elastic gear deformation	Application	Gear material	Tooth profile geometry	Materials processing & heat treatment
10:30	Coffee break – meet & greet at the exhibition area, poster presentation area and GearLab				
11:15	Profile modifications	Diagnosis, damage detection	Multi body systems, control	Special applications	Manufacturing related product properties
13:15	Closing remarks	Closing remarks	Closing remarks	Closing remarks	Closing remarks
13:30	<b>Awarding of the best presentation for junior engineers in the main hall by the conference president Prof. Dr.-Ing. Karsten Stahl</b> + Lunchtime snack				
15:00	End of the conferences				

# Gears 2019

Europe invites the world!

## 1<sup>st</sup> Conference day Wednesday, September 18<sup>th</sup>, 2019

08:30 Registration



### Plenary lectures



09:30 **Common welcome and opening by the president of the International Conference on Gears 2019**

**Prof. Dr.-Ing. Karsten Stahl**, FZG, Technische Universität München (TUM), Garching, Germany



09:45 **Welcome address by**

**Matthew E. Croson**, President, American Gear Manufacturers Association (AGMA), Alexandria, USA &



**Dr.-Ing. Arbogast M. Grunau**, FVA, Frankfurt a.M. & Schaeffler Technologies AG & Co. KG, Herzogenaurach, Germany

10:00



### Keynote session: From system to atom – digital twins on all scales?

**Moderation: Prof. Dr.-Ing. Karsten Stahl**, FZG, Technische Universität München (TUM), Garching, Germany

#### Looking into small scale drives driving technology

- Advantage of digital twins
- Preconditions for digital twins
- Digital twins on various scales



**Dr.-Ing. Arbogast M. Grunau**, President of the Managing Board, Research Association for Drive Technology (FVA), Frankfurt a. M., Principal Expert Bearings, Schaeffler Technologies AG & Co. KG, Herzogenaurach, Germany

#### Challenges in modeling multi-scale physics in gear contact problems

- Explanation of the multi-disciplinary and multi-scale nature of gear contact problems
- Introduction of models for elastohydrodynamic lubrication, surface wear, and micro-pitting to demonstrate the multi-scale nature of gear contact problems
- Shortcomings of current models in capturing sub-micron effects in a physics-based manner
- Identification of research topics towards bridging gaps in multi-scale gears



**Prof. Ahmet Kahraman**, Winbigler Professor and Director, Gear and Power Transmission Research Laboratory and Pratt & Whitney Center of Excellence in Gearbox Technology, Department of Mechanical and Aerospace Engineering, The Ohio State University, Columbus, USA

#### Atomistic simulations in tribology: potentials, perspectives and limitations

- Tribological processes hidden at buried interfaces
- Evolution of materials structure and chemistry under tribological loading
- Lubricants in nanoscale gaps: from tribochemistry to rheology at extreme pressure
- The great challenge: bridging length and time scales



**Dr. Gianpietro Moras**, Deputy Group Leader, Multiscale Modelling and Tribosimulation, Prof. Dr. rer. nat. Michael Moseler, Group Leader, Multiscale Modelling and Tribosimulation, Fraunhofer Institute for Mechanics of Materials IWM, Freiburg, Germany



11:45 **Time for a working lunch** – meet & greet at the exhibition area, poster presentation area and GearLab

Every participant gets a voice – you will be involved by digital polls during the speeches.

### Lecture Room A



#### Flank strength

**Moderation:** Dr.-Ing. Ralf Georg Wittor, Eickhoff Antriebs-technik, Germany/Prof. Ahmet Kahraman, The Ohio State University, USA

#### 13:15 Influence of gear surface roughness on pitting and micropitting life

- In situ measurement of the gear flank in FZG pitting test
- Comparison of gears with super finished and ground surface

**Edwin Bergstedt, M. Sc.**, Ph. D. student, Department of Machine Design, KTH Royal Institute of Technology, Stockholm, Sweden, Jiachun Lin, Ph. D., Associate Professor, Department of Instrument Science and Technology, Beijing University of Technology, China, Per Lindholm, Ph. D., Simulation specialist, Contact mechanics, ABB Corporate Research, Västerås, Sweden

#### 13:45 Influence of stressed volume of tooth flank on the surface durability

- Introduction of big influencing factor on the surface durability of dedendum tooth flank of pinion
- Improvement of tooth flank durability calculation for pinion of small tooth number

**Prof. Dr.-Ing. h. c. Aizoh Kubo**, Manager of R&D, President of Research Institute for Applied Sciences, Kyoto, Japan

#### 14:15 Transfer of the tooth flank stress into an analogy test concept to provoke the damage pattern tooth flank fracture

- Analogy test rig to investigate tooth flank fractures
- Double pulsator: Tooth flank fracture, load capacity, experimental investigation

**Fabian Goergen, M. Sc.**, Research Assistant, Dr.-Ing. Dipl.-Wirt.-Ing. Christoph Löpenhaus, Chief Engineer Gear Technology, Gear Department, Prof. Dr.-Ing. Christian Brecher, Full Professor, Chair of Machine Tools, Laboratory for Machine Tools and Production Engineering (WZL), RWTH Aachen University, Germany

#### 14:45 Effect of surface characterization induced by fine shot peening on scuffing of steel roller

- Influence of surface characterization on scuffing
- Improvement of scuffing resistance

**Yuya Omiya, Ph. D.**, Assistant Professor, Masahiro Fujii, Ph. D., Professor, Graduate School of Natural Science and Technology, Okayama University, Japan



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

### Lecture Room B



#### NVH

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

#### Bionic tooth root: fatigue testing and potential on gear units

- Reduction of tooth root stress by bionic toothing
- Potentials of bionic toothing - acoustic

**Dipl.-Ing. Florian Lubos**, Design Engineer, TTM: Systems & Special Topics, Dipl.-Ing. Zsolt Roth, Developing Engineer, Centre of Competence Toothing & Bearings, J.M. Voith SE & Co. KG | VTA, Heidenheim, Germany

#### Planetary gears: excitation modes, noise and modifications

- Vibration behavior of planetary gears
- Influence of modifications

**Dr.-Ing. Michael Heider**, Calculation engineer, Andreas Beistingel, M. Sc., Ph. D. student, Dr.-Ing. Burkhard Pinnekamp, Head of Central Technology, Renk AG, Augsburg, Germany

#### Noise characteristics induced by micro-pitting formed on particle-based parkerized gears

- Influence of surface treatment on micropitting
- Relationship between micropitting and gear noise

**Ryohei Saito**, Development Manager, Hardware System Development Department, Dr.-Ing. Yoshitomo Suzuki, Engineering Management Department, JATCO Ltd., Kanagawa, Dipl.-Ing. Kouji Matsuo, Hardware System Development Department, JATCO Ltd., Shizuoka, Japan

#### Experimental study of the whining noise for a railway gearbox

- Vibroacoustic behavior of a true railway gearbox
- Experimental measurements and numerical simulations

**Karl Landet, M. Sc.**, Ph. D. student, Joël Perret-Liaudet, Associate Professor, Emmanuel Rigaud, Associate Professor, LTDS - Laboratoire de Tribologie et Dynamique des Systèmes, Ecole Central de Lyon, Ecully, France

### Lecture Room C



#### Efficiency

**Moderation:** Ir. J.J. Bos, Schelde Gears, The Netherlands/Prof. Ing. Carlo Gorla, Politecnico di Milano, Italy

#### Windage power loss reductions in high-speed gear pairs

- Windage power loss of a pinion and pinion-gear pair compared
- Numerical CFD and experimental approach

**Prof. Dr.-Ing. Philippe Velex**, Full Professor, LaMCoS, INSA – Institut National des Sciences Appliquées de Lyon, Villeurbanne Cedex, Dr. Yann Marchesse, Academic Researcher, Department of energy, ECAM Lyon, France

#### Power loss analysis of different high power density gearbox typologies: CFD analysis and experimental measurements on a cycloidal gear set

- Efficiency calculation of cycloidal gearbox
- CFD simulations of churning and lubricant fluxes

**Franco Concli, Ph. D.-Ing.**, Assistant Professor, Ing. Lorenzo Maccioni, Faculty of Science and Technology (FaST), Free University of Bolzano, Prof. Ing. Carlo Gorla, Associate Professor, Department of Mechanical Engineering, Politecnico di Milano, Italy

#### Scaling of planetary gear stages according to gear loss similarity

- Possibility to investigate high power gearboxes with limited testing capability
- Reducing size and power of a test gearbox by keeping similarity regarding load dependent gear losses

**Felix Siglmüller, M. Sc.**, Research Associate, Gear Research Centre (FZG), Technische Universität München, Garching, Germany

#### Analysis on the efficiency of a coaxial hyperbolic gearbox

- Calculation and conjugation of worm and hyperbolic gear
- Comparison of calculated and measured efficiency

**Florian Eigner, M. Sc.**, Research Assistant, TU Chemnitz, Germany

## Lecture Room A

**Tooth root strength**  
**Moderation: Dipl.-Ing. Zsolt Roth**, Voith Turbo, Germany/  
**Prof. Dr. Geng Liu**, Northwestern Polytechnical University, China

**16:00 Optimized tooth root strength by controlled shot peening**  
 • Variation of shot-peening parameter and surface after shot peening  
 • Influence of shot peening on the fatigue behavior of gears  
**Dr.-Ing. Jürgen Hoffmeister**, Head of Materials Technology, Dr.-Ing. Jörg Hermes, Managing Director, Innovation Mechanics, SEW-Eurodrive GmbH & Co. KG, Bruchsal, Germany

**16:30 Optimisation of spur gear tooth fillet for maximum bending strength using Bezier curves**  
 • Minimization of tooth-root stresses  
 • Modified tooth root geometry using Bezier Bernstein polynomials  
**Georgios Vasileiou, M. Sc.**, Nikolaos Rogkas, M. Sc., both PhD candidate/Research Assistant, Prof. Dr. Vasilios Spitas, Professor, School of Mechanical Engineering, National Technical University of Athens, Greece

**17:00 Simulation of the tooth root strength under consideration of material quality, finishing process and size effects**  
 • Prediction of the tooth root reliability  
 • Comparison to ISO-6336-3 /-5 and test data  
**Dipl.-Ing. Jean-André Meis**, Head of Simulation and Data Analytics, Technology and Innovation, Flender GmbH, Bocholt, Germany

**17:30 Flank load capacity of hard-soft gear pairings**  
 • Pitting damages on through hardened gear flanks  
 • Influence of lubrication and wear on gear failures  
**Dipl.-Ing. Andreas Dobler**, Team Leader Geometry and Lubrication, Dr.-Ing. Thomas Tobie, Head of Department, Prof. Dr.-Ing. Karsten Stahl, Full Professor, Institute of Machine Elements, Director, Gear Research Centre (FZG), Technische Universität München (TUM), Garching, Germany

**18:15 Organized bus transfer to the evening reception**

**19:00 Evening reception at the Paulaner am Nockherberg**  
 You can look forward to a special evening event. We cordially invite you to our evening reception at the Paulaner am Nockherberg, one of the most traditional breweries in Munich. Enhance your personal network and use informal atmosphere for deeper-going discussions.



**Dinner speech**  
**Dr.-Ing. E. h. Manfred Wittenstein**, Chairman of the Supervisory Board, WITTENSTEIN SE, Igersheim, Germany

## Lecture Room B

**Loaded tooth contact analysis**  
**Moderation: Prof. Dr.-Ing. Berthold Schlecht**, Technical University of Dresden, Germany/  
**Prof. Haruo Houjoh**, Prof. Emeritus, Tokyo Institute of Technology, Japan

**A worm grinding method of face gears based on the optimization of dressing wheel profile**  
 • The path of the trimming worm is easy to plan  
 • The initial installation position of the worm is easy to implement  
**Xianlin Shi**, Student, Assoc. Prof. Yuansheng Zhou, Ph. D., Associate Professor, Prof. Jinyuan Tang, Associate Professor, Mechanical and Electrical Department, Central South University, Changsha, China

**FEM analysis of the load distribution over the face width of helical gear pairs considering deviations, misalignments and deformations**  
 • Load distribution over the face width of helical gears  
 • Advanced finite element analysis  
**Prof. Dr.-Ing. Athanassios Mihailidis**, Full Professor, Head of the Laboratory of Machine Elements and Machine Design, Mechanical Engineering, Dipl.-Ing. Andreas Psarros, Ph. D. candidate, Aristotle University of Thessaloniki, Greece

**Improved tooth contact analysis by using virtual gear twins**  
 • Flank modifications by using digital twins  
 • Ideas for using AI to find the best flank modification  
**Dr.-Ing. Tobias Schulze**, Managing Director, DriveConcepts GmbH, Dresden, Germany

**Co-simulation of the tooth contact of bevel gears within a multi-body simulation (MBS)**  
 • Enhanced loaded tooth contact analysis for MBS simulations  
 • Stress analysis of bevel gears in MBS simulations  
**Dipl.-Ing. Wolf Wagner**, Research Assistant, Dr.-Ing. Stefan Schumann, Oberingenieur, 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

## Lecture Room C

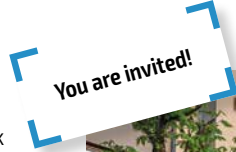
**Condition monitoring**  
**Moderation: Dr.-Ing. Reiner Vonderschmidt**, Georgii Kobold, Germany/  
**Prof. Dr.-Ing. Dr. h. c. Albert Albers**, KIT, Germany

**Condition monitoring of gearboxes using magnetoresistive sensors**  
 • Monitoring of gear and bearing wear using magnetic sensors  
 • Development of new hard- & software to support predictive maintenance  
**Dr. Rolf Slatter**, CEO and Managing Partner, Sensitec GmbH, Lahnau, Germany

**Deep online oil analysis of dielectric parameters for life time enhancement of industrial gearboxes**  
 • Optimization of O&M of gears by condition based decisions  
 • Visualization of short & long-term changes of the lubricant  
**Prof. Dr.-Ing. Manfred Mauntz**, CEO and Head of R&D, Dr. rer. nat. Jörg Peuser, Applications, cmc Instruments GmbH, Eschborn, Germany

**Comparing data sources for condition monitoring suitability**  
 • Condition monitoring: cylindrical gears, tooth root failure, running-in vs. damage  
 • Data acquisition acceleration signals, angular data, data quality  
**Dipl.-Ing. Max Fromberger**, Team Leader Software, Prof. Dr.-Ing. Karsten Stahl, Full Professor, Institute of Machine Elements, Director, Gear Research Centre (FZG), Technische Universität München (TUM), Garching, Germany

**Monitoring concept study for aerospace power gear box drivetrain**  
 • Diagnostic methods for detecting gear transmission damages  
 • Vibration sensor on rotating gears using wireless transmission  
**Mateusz Grzeszkowski, M. Sc.**, Noushin Mokhtari, M. Sc., both Research Assistant, Department of Energy and Automation Technology, Chair of Electronic Measurement and Diagnostic Technology (MDT), Technical University of Berlin, Dr. Sebastian Nowoisky, System Architect, R&T tech lead on power gear gearbox monitoring system, Rolls-Royce Deutschland Ltd. & Co. KG, Dahlewitz, Germany



Source: @ Nockherberg

2<sup>nd</sup> Conference day  
Thursday, September 19<sup>th</sup>, 2019

Lecture Room A



**Strength**

**Moderation:** Dr.-Ing. Ulrich Knödel, GETRAG, Germany/  
Prof. Dr. Eng. Ichiro Moriwaki, Kyoto Institute of Technology,  
Japan

08:30 **Investigations on non-metallic inclusion crack area characteristics in case carburized and shot-peened high strength gears of different sizes made of high-quality steels**

- Crack area characteristics of non-metallic inclusions
- Degree of cleanliness

**Daniel Fuchs, M. Sc.**, Research Associate, Dr.-Ing. Thomas Tobie, Head of Department, Gear Research Centre (FZG), Technische Universität München, Garching, Dr.-Ing. Stefan Schurer, Subproject Manager, Department of technology development of gear parts, MAN Truck & Bus AG, Munich, Germany

09:00 **Investigations on the pitting load capacity of internal spur and helical gears**

- Flank load carrying capacity of internal gears
- Influence of the helix angle

**Michael Geitner, M. Sc.**, Research Associate, Dr.-Ing. Thomas Tobie, Head of Department, Prof. Dr.-Ing. Karsten Stahl, Full Professor, Institute of Machine Elements, Director, Gear Research Centre (FZG), Technische Universität München (TUM), Garching, Germany

09:30 **Wear prediction for double helical gears grinded by forming method**

- Wear model include residual stress of double helical gears is proposed
- Study the effects of grinding parameter on gear wear

**Changjiang Zhou, Ph. D.**, Professor, Hongbing Wang, Ph. D. candidate, Xiumen Wen, Postgraduate, College of Mechanical and Vehicle Engineering, Hunan University, Changsha, China

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

Lecture Room B



**Transmission error**

**Moderation:** Prof. Dr. D. Houser, Professor Emeritus,  
Ohio State University, USA/**Dipl.-Ing. Dirk-Olaf Leimann**, former  
ZF Wind Power Antwerpen, Belgium

**Investigation of transient response motion of differential planetary gear train during reverse rotation and starting by using high-speed camera monitoring**

- Transient response in the case of reverse rotation
- A novel train named ZK-HV PGT having a clear acrylic carrier

**Tomoki Fukuda**, Student, Manufacturing System Design Laboratory, Doshisha University, Kyoto, Japan

**Research on dynamics transmission error of nutation gear pairs and magnetic characteristics of noncontact nutation drive**

- Influence of the assembly errors and variable loads on dynamics transmission error
  - Analyzed the structure characteristics of the two kinds of magnetic gears and the distributions of the drive torque with the slip angle
- Yongwu Cai**, Ph. D. candidate, Prof. Ligang Yao, Ph. D., Dean of Mechanics Institute, Meiyuan Lou, Ph. D. candidate, Dingjian Huang, Ph. D., School of Mechanical Engineering and Automation, Fuzhou University, China

**Experimental and numerical investigation of helical gear transmission error under gear misalignments**

- Influence of the gear misalignment on transmission error
- Comparison of dynamic analysis over experimental data

**Daehyun Park, Ph. D.**, Research Engineer Advanced, Research and Technology Development, Siemens Industry Software NV, Leuven, Belgium

Lecture Room C



**Bevel and hypoid design and manufacturing**

**Moderation:** Prof. Dr. Alfred J. H. Schoo, Westfälische Hochschule Gelsenkirchen Bocholt Recklinghausen, University of Applied Sciences Bocholt, Germany/**Dr.-Ing. Joachim Thomas**, ZG Hypoid, Germany

**Optimization of hypoid gear macro/micro geometries for high efficiency drives, taking into consideration of NVH and strength**

- Effect of hypoid gear macro geometries and micro geometries on friction loss
- Evaluation of side effects on strength and noise

**Dipl.-Ing. Kazuhiro Takaki**, Powertrain production engineering Manager, Masaki Sugimoto, Expert Leader, Powertrain Planning Department, Nissan Motor Co., Ltd., Kanagawa, Japan

**Design and CnC manufacturing of face milled beveloid gears**

- Novel alternative to "conventional" cylindrical and beveloid gears using dish type face mill cutters
- Allows easy and fast manufacturing on 5 axis CnC machines, with closed loop and reverse engineering

**Prof. (ret.), Claude Gosselin, Ph. D.**, CEO, Involute Simulation Softwares Inc., Quebec, Canada, Eberhard Fritz, Manager Product Development, Lucas Seiler, CMM & CNC, ESA Eppinger GmbH, Denkendorf, Germany

**Analytical design method for beveloid gears with a small shaft angle and offset**

- Main gearing data of involute gears with skew axes
- Centred contact pattern with predefined gear backlash

**Daniel Marino, M. Sc.**, Research Assistant, Institute for Engineering Design and Industrial Design, Prof. Dr.-Ing. Hansgeorg Binz, Head of Institute, Dipl.-Ing. Matthias Bachmann, Team Leader, IKTD, University of Stuttgart, Germany



## Geometry, quality

**Moderation:** **Dr.-Ing. Rolf Döbereiner**, MAGNA POWERTRAIN, Austria/**Dr.-Ing. Toni Weiss**, Gear Consultant, ret. from Renk, now GanaCon – Gear analysis and Consulting, Germany

### 10:45 Optimization of asymmetric gear tooth root generated with protuberance hob

- Describes asymmetric gears produced with a protuberance hob
- Introduces tooth root optimization of these asymmetric gears

**Dr. Alex Kapelevich**, President, Dr. Yuriy Shekhtman, Senior Researcher, AKGears, LLC, Shoreview, USA

### 11:15 DIN Q6 meets DIN Q10 - needs of modern internal gear production

- Requirements to internal gear series production of DIN Q8
- Measuring and quality assurance of ring gears

**Dipl.-Ing. Thomas Kleiber**, Senior Specialist Gear Development, Dipl.-Ing. (FH) Andreas Hofmann, Team Coordinator, Dr.-Ing. Benedikt Neubauer, Head of Department, Product Group Gearing, Schaeffler Technologies AG & Co. KG, Herzogenaurach, Germany

### 11:45 Prediction of transmission accuracy lifetime of Rot Vector (RV) gearbox

- A novel method for predicting the transmission accuracy
- Influence of operating conditions on the accuracy lifetime

**Chang Liu, Ph. D.**, Student, Mechanical Engineering, Dr. Wankai Shi, Professor, Automotive Engineering, Chongqing University, China, Dr. Francesca Maria Curà, Professor, Mechanical and Aerospace Engineering, Politecnico di Torino, Italy

### 12:15 Parametric study of 3D trochoidal reducer model with involute profile

- 3D dynamic behavior of a new kind of internal gear contracts: trochoidal reducer
- New profile of tooth, based on a standard involute profile

**Tommy Pinel, M. Eng.**, Engineer R&D, Moving Magnet Technologies S. A., Besancon, Prof. Dr.-Ing. Philippe Velez, Full Professor, LaMCoS, INSA – Institut National des Sciences Appliquées de Lyon, Villeurbanne Cedex, France

**12:45 Time for a working lunch** – meet & greet at the exhibition area, poster presentation area and GearLab



## Dynamic

**Moderation:** **Prof. Dr.-Ing. Georg Jacobs**, RWTH Aachen University, Germany/**Prof. Dr.-Ing. José I. Pedrero**, Universidad Nacional de Educación a Distancia (UNED), Spain

### Investigation of dynamic modeling and vibration transmission characteristics of helicopter main gearbox

- Dynamic modeling of the helicopter main gearbox considering structural flexibility
  - Identifying the dominant transmission path of resonance energy
- Huachao Xu**, Student, Prof. Dr. Datong Qin, Full Professor, Deputy Director of Academic Committee, State Key Laboratory of Mechanical Transmission, Chongqing University, China

### Dynamic behavior of tractor PTO driveline to analyze a rattle noise

- Rattle noise level reflecting system dynamic characteristics
  - Influence of operating speed on gear rattle noise
- Hyoung Jong Ahn, Master**, Associate Research Engineer, Master Chanhoo Choi, Senior Engineer, Jihun Yu, Ph. D., Project manager, Tractor advanced development group, LS Mtron, Gyeonggi-do, South Korea

### Dynamic models for structural health monitoring of gearboxes

- Dynamic modelling via FE approach
  - Structural health monitoring of a back-to-back (FZG) test rig
- Franco Concli, Ph. D.-Ing.**, Assistant Professor, Faculty of Science and Technology (FaST), Free University of Bolzano, Prof. Ing. Carlo Gorla, Associate Professor, Department of Mechanical Engineering, Politecnico di Milano, Italy

### Dynamic simulation analysis of two-input compound-split mechanism for Wheel Drive EV.

- Dynamic analysis of planetary gears with two-input excitation
- The influence of variable speed time of two-input on system shock vibration

**Xiaodong Yang**, Ph. D. Candidate, College of Mechanical Engineering, Mechanical engineering postdoc Liming Wang, Researcher, Ph. D. in engineering, Yimin Shao, Professor, Mechanical system dynamic, Chongqing University, China



## Bevel and hypoid endurance

**Moderation:** **Prof. Dr.-Ing. Manfred Hirt**, Germany/**Prof. Dr.-Ing. Vojislav Miltenovic**, University of Niš, Republic of Serbia

### Design and rating by means of loaded TCA of straight bevel differential gears

- Design of differential gear sets
- Loaded tooth contact analysis of differential gear sets

**Dr.-Ing. Joachim Thomas**, Managing Director, ZG Hypoid GmbH, Aschheim, Germany, Claude Gosselin, P. Eng., Ph. D., Involute Simulation Softwares Inc., Quebec, Canada

### Investigation of meshing phenomenon of hypoid gears with different offsets via high response infrared video thermography

- Tooth contact evaluation using infrared ray imagery
- Relationship between tooth surface temperature and tooth root stress

**Koki Mukaiyama**, Master, Manufacturing System Design Laboratory, Doshisha University, Kyoto, Japan

### New calculation method of the micropitting load carrying capacity of bevel and hypoid gears

- Investigations on the micropitting load carrying capacity
- Calculation method for bevel and hypoid gears

**Josef Pellkofer, M. Sc.**, Research Associate, Dr.-Ing. Michael Hein, Head of Department worm and bevel gears, Prof. Dr.-Ing. Karsten Stahl, Full Professor, Director, Gear Research Centre (FZG), Technische Universität München, Garching, Germany

### Transient 3D TEHL simulation of spiral bevel gears under mixed friction conditions

- Detailed insight into the lubricated tooth flank contact
- Realistic mapping of tooth flank geometry

**Dipl.-Ing. Ronny Beilicke**, Project Engineer, Tribo Technologies GmbH, Dr.-Ing. Lars Bobach, Research Assistant, Prof. Dr.-Ing. habil. Dirk Bartel, Head of, Chair of Machine Elements and Tribology, Otto von Guericke University, Magdeburg, Germany





### Lubrication, EHL

**Moderation:** Prof. Dr.-Ing. Gerhard Poll, Leibniz University Hannover, Germany/Prof. Ray Snidle CEng FREng, Cardiff University, United Kingdom

#### 14:15 Tribo-dynamics model of a spur gear pair with gyroscopic effect and flexible shaft

- Coupling effect of gear dynamics and lubrication
- Influence of the gyroscopic effect on gear lubrication

**Bo Hu, Ph. D.**, Student, Changjiang Zhou, Ph. D., Professor, College of Mechanical and Vehicle Engineering, Hunan University, Changsha, China

#### 14:45 Calculation of mixed friction conditions in large-scale rolling-sliding contacts for different surface structures

- Introduction of a lubricant boundary condition for the contact problem of the elastic half-space
- Validation of calculation by different Stribeck-Curves

**Dieter Mevissen, M. Sc.**, Research Assistant, Dr.-Ing. Dipl.-Wirt.-Ing. Christoph Löpenhaus, Chief Engineer Gear Technology, Gear Department, Prof. Dr.-Ing. Thomas Bergs, Full Professor, Laboratory for Machine Tools and Production Engineering (WZL), RWTH Aachen University, Germany

#### 15:15 White etching crack bearing failure: identification of high risk lubricant compounds using artificial neural networks

- Classifying WEC risk of oils based on constituting compounds
- Identifying influential compounds on WEC risk classification

**Baher Azzam, M. Sc.**, Research Assistant, Wind Farm Development, Center for Wind Power Drives, RWTH Aachen University, Germany



#### 15:30 Coffee break – meet & greet at the exhibition area, poster presentation area and GearLab



### Lubrication, flank strength

**Moderation:** Dr.-Ing. Carsten Gitt, Daimler, Germany/Dipl.-Ing. Dirk-Olaf Leimann, former ZF Wind Power Antwerpen, Belgium

#### 16:30 Defining wear limits for rack and pinion for offshore jacking applications

- Rack and pinion life assessment
- Impact of plastic deformation to the life expectation

**Dipl.-Ing. (FH) Adrian Nowoisky**, Senior Product Engineer, Design Engineering, Dana Incorporated, Lafayette, USA



### Worm and crossed axis helical gears

**Moderation:** Prof. Dr.-Ing. Bernd Sauer, University of Kaiserslautern, Germany/Prof. Dr.-Ing. Athanassios Mihailidis, Aristotle University of Thessaloniki, Greece

#### Prediction of heat generation of crossed axis gearbox

- Prediction of gearbox thermal stability
- Heat generation of crossed axis gearbox

**Dr.-Ing. Aleksandar Miltenovic**, Assistant Professor, Department for mechanical design, development and engineering, Dr.-Ing. Milan Banić, Assistant Professor, Faculty of Mechanical Engineering, Dr.-Ing. Vojislav Miltenović, Full Professor, Innovation Center, University of Niš, Serbia

#### A method to determine wear locally in worm gears with highly resolved circumferential backlash curves

- Wear monitoring in worm gears by measuring locally backlash
- Tangential composite inspection of assembled worm gears

**Dipl.-Ing. Kevin Daubach**, Research Assistant, Prof. Dr.-Ing. Bernd Sauer, Head of Institute, Dr.-Ing. Manuel Oehler, Research Assistant, Institute of Machine Elements, Gears and Transmissions, Technische Universität Kaiserslautern, Germany

#### Curvature interference characteristic of conical worm gear

- The method to compute curvature interference limit line
- Numerical example studies

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



### Calculation/standard

**Moderation:** Prof. i. R. Dr.-Ing. Bernd-Robert Höhn, Technische Universität München (TUM), Germany/Eng. Amir Aboutaleb, American Gear Manufacturers Association, USA

#### ISO Standard method for determining a global in-operation dynamic factor KAV in gears subjected to variable velocity and loading conditions

- Global dynamic factor determination in ISO Standard environment
- Bending fatigue of gears

**Francesca Curà**, Associate Professor, Mechanical and Aerospace Engineering, Politecnico di Torino, Italy



### Bevel and hypoid transmission error

**Moderation:** Dr.-Ing. Hartmut Faust, Schaeffler Automotive Buehl, Germany/Prof. h. c. Dr.-Ing. Aizoh Kubo, Research Institute for Applied Sciences, Japan

#### A methodology for measurement of loaded transmission error of hypoid gear pair with misalignments

- Application of controlled misalignments to hypoid gears
- Measurement of the resulting loaded transmission error

**Hugo Blettery**, Research Engineer, Dr. David Talbot, Research Assistant Professor, Prof. Ahmet Kahraman, Winbigler Professor and Director, Gear and Power Transmission Research Laboratory and Pratt & Whitney Center of Excellence in Gearbox Technology, Department of Mechanical and Aerospace Engineering, The Ohio State University, Columbus, Ohio, USA

#### Dynamic model of bevel gear with friction damper

- Investigation of nodal diameters oscillation of bevel gear
- Optimization of plate friction damper

**Egor Kozharinov, Ph. D.**, Head of group Strength, resource and optimal design of aviation drives, Prof. Jury Temis, Professor, Head of Department Mathematical Modelling, Central Institute of Aviation Motors (CIAM), Moscow, Russia

#### An easy-to-use and fast computational model for the prediction of the influence of manufacturing errors on gear transmission error

- Influence of profile form, lead form and bias on NVH
- Parametric studies of dynamic excitation

**Dipl.-Ing. Andreas D. Rauch**, Development Engineer, Dr.-Ing. Christian Wirth, MAHLE ZG Transmissions GmbH, Eching, Germany



### Dynamics on planetary gears

**Moderation:** Prof. Dr.-Ing. Peter Tenberge, Ruhr-University Bochum/Prof. Dr.-Ing. Kiril Arnaudov, Professor Emeritus, Bulgarian Academy of Sciences, Bulgaria

#### Dynamic modeling and analysis of a star-wheel reducer

- Modelling for an analytical elastodynamic model considering the manufacturing/assembling errors
- Tests for experimental modal and vibration

**Prof. Jun Zhang, Ph. D.**, Doctoral advisor, School of Mechanical Engineering and Automation, Fuzhou University, China

**17:00 Determination of S-N curves for pitting based on local damage analysis**

- Damage data acquisition by optical measurement technique
- Damage evaluation with local tooth contact simulation

**Dipl.-Ing. Felix Müller**, Research Assistant, Dr.-Ing. Stefan Schumann, Oberingenieur, Prof. Dr.-Ing. Berthold Schlecht, Full Professor, Institute of Machine Elements and Machine Design, Faculty of Mechanical Science and Engineering, Technical University of Dresden, Germany

**17:30 Minimizing gear friction with water-containing gear fluids**

- Results on superlubricity with water-containing gear fluids at the efficiency gear test rig
- Evaluation of losses and temperatures for a wide range of loads, velocities and oil temperatures

**Mustafa Yilmaz, M. Sc.**, Research Associate, Dr.-Ing. Thomas Lohner, Head of Department, Prof. Dr.-Ing. Karsten Stahl, Full Professor, Institute of Machine Elements, Director, Gear Research Centre (FZG), Technische Universität München (TUM), Garching, Germany

**18:00 Hydrogen assisted rolling contact fatigue in thrust roller bearings**

- Hydrogen evolution due to lubricant degradation in bearings
- Comparison of damage effects with H-content of the bearing

**Dr.-Ing. Dominik Kürten**, Tribology, Dr. rer. nat. Andreas Kailer, Group leader, Fraunhofer Institute for Mechanics of Materials IWM, Freiburg, Germany

**18:30 Evening reception at the conference venue**

We are pleased to invite you to our evening reception at the end of the second conference day. Enhance your personal network and use the relaxed and informal atmosphere for deepening talks with other participants and speakers.



**Dinner speech**

**Prof. Dr. Changle Xiang**, Professor, Vice-President, Beijing Institute of Technology, Director, National Key Lab of Vehicle Transmission, China

**Reusable Engineering Exchange Standard (REXS) – standardized gear unit model**

- Exchange CAE models via open, standardized interface
- Provide digital twin in transmission development

**Dr. rer. nat. Moritz Keuthen**, Head of Modelling and Simulation, FVA Software Service GmbH, Garching, Germany

**Graph-based design language for single speed gear system concepts**

- Holistic approach for modelling gear systems with state of art tools
- Automated gears system design and spatial positioning of components

**Kevin Holder, M. Sc.**, Development Engineer Rail Drive Systems, ZF Friedrichshafen AG, Prof. Dr.-Ing. Corinna Salander, Chair for Railway Vehicle Technology, Institute of Machine Components (IMA), Priv.-Doz. Dr.-Ing. Stephan Rudolph, Institute of Aircraft Design, University of Stuttgart, Germany

**Investigation of the potential of using surrogate models in gear design process**

- Optimisation using surrogate models
- Faster design space exploration using surrogate models

**Jens Brimmers, M. Sc.**, Team Leader Gearbox NVH, Dr.-Ing. Dipl.-Wirt.-Ing. Christoph Löpenhaus, Chief Engineer Gear Technology, Prof. Dr.-Ing. Christian Brecher, Professor, Gear Department, Laboratory for Machine Tools and Production Engineering (WZL), RWTH Aachen University, Germany

**Wolfrom gearboxes for lightweight, human-centered robotics**

- Requirements in wearable robotics versus traditional industrial robots
- Suitability and potential of Wolfrom planetary gearboxes

**Pablo Lopez Garcia, M. Eng.**, Ph. D. Research Fellow, Mechanical Engineering Department (MECH), Vrije Universiteit Brussel, Belgium

**Impact of tooth profile modification on the whining noise emitted by a planetary gear set: experimental validation of a computational scheme**

- Dynamic simulation of planetary gear set
- Experimental measurement of different test cases

**Jessica Neufond**, Research Engineer, Ph. D. student, Numerical simulations, VibraTec SA, Ecully, France

**Influence of tooth profile modification on planetary gear sets dynamic**

- Dynamic model of planetary gear set
- Method of modelling the influence of tooth profile modification on transmission error

**Dmitry Kalinin**, Head of Aviation drives department, Prof. Jury Temis, Professor, Head of department Mathematical Modelling, Central Institute of Aviation Motors (CIAM), Moscow, Russia



Source: Uti Benz/TUM

**3<sup>rd</sup> Conference day**  
Friday, September 20<sup>th</sup>, 2019

**Lecture Room A**



**Elastic gear deformation**

**Moderation:** Dipl.-Ing. Norbert Haefke, FVA, Germany/**Prof. Dr. Changle Xiang**, National Key Lab of Vehicle Transmission, China

**08:30 Investigation of the influence of elastic gear body structures on the operational behavior of gears**

- Calculation method for including elastic gear body structures in the tooth contact analysis
- Influence of elastic gear body structures on the operational behavior of gears

**Philipp Scholzen, M. Sc.**, Research Assistant, Laboratory for Machine Tools and Production Engineering (WZL), RWTH Aachen University, Dipl.-Ing. Daniel Billenstein, Universität Bayreuth, Dipl.-Ing. Georg Hammerl, FVA GmbH, Frankfurt a.M., Germany

**09:00 Consideration of elastic deformations of gear bodies using reduction on a fourier series**

- Effect of gear body deformations on flank line load distribution of cylindrical gears
- Approach to consider elastic deformations of gear bodies in a coupled shaft system calculation

**Markus Raabe**, Director, MESYS AG, Zürich, Switzerland

**09:30 A gear load distribution model for planetary gear set with a flexible carrier**

- Planetary Gear Set Load Distribution
- Flexible Carrier

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

**Lecture Room B**



**Application**

**Moderation:** Dr.-Ing. Ralf Hess, Flender, Germany/**Prof. h. c. Dr.-Ing. Aizoh Kubo**, Research Institute for Applied Sciences, Japan

**Experimental and theoretical study of load mesh factor for different boundary conditions in wind gearbox planetary stages**

- Load share in relation to number of planets
  - Simulation correlation with testing
- Iñaki Ruiz de Ocenda, E. Eng.**, Gearbox Validation/Test Engineer, **Harri Aurrekoetxea, M. Eng.**, Gamesa Energy Transmissions SAU, Zamudio, Spain

**A study of gear oil performances contributing to wind turbine lifetime extensions**

- The lubricants properties of protecting gears assuming a severe use
- Derivation of promising oil for long time use of wind turbine gearbox

**Sho Yokoyama, Master**, Development Engineer, Industrial Lubricants Group, Lubricants Research Laboratory, Idemitsu Kosan Co., Ltd., Ichihara, Japan

**Optimized electrified drivetrains and duty cycle testing methods related to future autonomous driving vehicle concepts**

**Prof. Dr. Ralf Wörner**, Professor, hofer power-train GmbH, Dr. rer. nat. Dipl.-Phys. Mathias Lutz, hofer-pdc GmbH, Technical Management/Head of System Analysis, Stuttgart, Lino Pott, Scientific Assistant, University of Applied Sciences, Esslingen a. N., Germany

**Lecture Room C**



**Gear material**

**Moderation:** Dr.-Ing. Jörg Hermes, SEW-EURODRIVE, Germany/**Prof. Dr.-Ing. Michael Weigand**, Vienna University of Technology, Austria

**Conventional high-strength nodular graphite iron as a substitute for austempered ductile iron (ADI)**

- Mechanical and microstructural characterization of GJS
- Investigation of the influence of graphite and matrix structure

**Dr.-Ing. Jürgen Hoffmeister**, Head of Department, Dr.-Ing. Jochen Lohmiller, R&D Engineer, Materials Technology, Dr.-Ing. Jörg Hermes, Managing Director, Innovation Mechanics, SEW-Eurodrive GmbH & Co. KG, Bruchsal, Germany

**Japanese standardization for gear steel qualification via evaluation of HV-scattering**

- Scattering of micro-Vickers' hardness and gear steel quality
- Preparation of input data to AI-system for steel quality judgement

**Prof. Dr.-Ing. h. c. Aizoh Kubo**, Manager of R&D, President of Institute, Dr.-Ing. Masahiro Nagae, Head researcher, Material department, Dr.-Ing. Kazuhiro Kawasaki, Board member, Research Institute for Applied Sciences, Kyoto, Japan

**Modelling high power geared transmissions, introduction of a filling material**

- Influence of dissipative properties of material on gears
  - Hybrid-dynamic substructure model
- Cyril Chevrel-Fraux**, Ph. D. student, Dr. Jérôme Bruyère, Associate Professor, Prof. Dr.-Ing. Philippe Velez, Full Professor, LaMCoS, INSA – Institut National des Sciences Appliquées de Lyon, Villeurbanne Cedex, France

**Lecture Room D**



**Tooth profile geometry**

**Moderation:** Dr.-Ing. Jörg Börner, ZF Friedrichshafen, Germany/**Prof. Dr. Eng. Ichiro Moriwaki**, Kyoto Institute of Technology, Japan

**Tooth contact analysis of non-circular gears with non-involute tooth profiles: Application to horological spur gears**

- Contact detection procedure
  - Reduction of torque variations
- Matthieu Chapron, Ph. D.**, R&D Engineer, Dr.-Ing. Quentin Theurillat-Bonjour, R&D Engineer, Montres Breguet SA, L'Orient, Switzerland

**Derivation of tooth stiffness of asymmetric gears for loaded tooth contact analysis**

- Adaption of Weber/Banaschek stiffness calculation and comparison and discussion of effects onto gear results due to asymmetry of teeth
- Verification of results with FEM

**Benjamin Mahr, MAS B. Eng.**, Head of Development/Development Engineer, KISSsoft AG, Bubikon, Switzerland, Dr.-Ing. Aljaz Pogacnik, Gear consultant, Bauhar s.p., Bled, Slovenia, Dr.-Ing. Andreas Langheinrich, Development Drive Technology, Horst Scholz GmbH & Co. KG, Kronach, Germany

**Tooth root bending capacity – an analysis of stress and strength**

- Not captured effects by the standard on tooth root bending stress
- Suggestions for further development of the load capacity calculation

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

**10:00 Hybrid models for the study of gear body dynamic deflection – modes of the gear body**

- Original hybrid lumped parameter/FE model to simulate thin-rimmed flexible gears
- Dynamic analysis of thin-rimmed/-webbed gears with disk like mode behavior, influence on mesh dynamic loading

**Berengere Guilbert, Ph. D.**, Associate Professor, Prof. Dr.-Ing. Philippe Velex, Full Professor, LaMCoS, INSA – Institut National des Sciences Appliquées de Lyon, Villeurbanne Cedex, Ing. Philippe Cutuli, SAFRAN Helicopter Engines, Bordes, France

**Two-speed transmission based on energy-efficient MRF-coupling elements and power split mechanics**

- Energy-efficient MRF-based coupling elements
- Two-speed transmission based on a mechanical power split

**Christian Hegger, M. Sc.**, Research Assistant, Prof. Dr.-Ing. Jürgen Maas, Principal of Mechatronic Systems Laboratory, Technische Universität Berlin, Germany

**Gear design beyond current standards**

- Systematic Mapping of gear material fatigue performance
- Implementing increased material fatigue performance in gears

**Elias Löthman, M. Sc.**, Application Engineer, Lily Kamjou, M. Sc., Senior Specialist Powertrain, Erik Claesson, M. Sc., Head of Industry Solutions Development, Ovako AB, Hofors, Sweden

**Experimental verification of improvements in static and fatigue bending capacity of spur gear tooth root design optimization**

- Numerical predictions and verification by measurements of tooth root strains/stress
- Experimental investigation of single tooth bending fatigue lives

**Dr. Nihat Yildirim**, Department of Mechanical Engineering, Faculty of Engineering, Gaziantep University, Prof. Mustafa Yasar, Lecturer, Department of Industrial Design Engineering, Karabuk University, Fatih Erdogan, Mechanical Engineer, AeroGDT Power Trans. Inc., Ankara, Turkey

**10:30 Coffee break** – meet & greet at the exhibition area, poster presentation area and GearLab

**Lecture Room A**



**Profile modifications**

**Moderation: Prof. Dr.-Ing Karsten Stahl**, Technische Universität München (TUM), Germany/**Prof. Bingkui Chen**, Chongqing University, China

**Lecture Room B**



**Diagnosis, damage detection**

**Moderation: Dr.-Ing. Burkhard Pinnekamp**, Renk, Germany/**Prof. Dr. Datong Qin**, Chongqing University, China

**Lecture Room C**



**Multi body systems, control**

**Moderation: Dr.-Ing. Bernhard Bouché**, Getriebebau NORD, Germany/**Dr. Michel Octrue**, CETIM (Technical Center for Mechanical Engineering Industries), Senlis Cedex, France

**Lecture Room D**



**Special applications**

**Moderation: Prof. i. R. Dr.-Ing. Bernd-Robert Höhn**, Technische Universität München (TUM)/**Prof. Dr. Eng. Jože Duhovnik**, University of Ljubljana, Slovenia

**11:15 Conjugate tooth profile of circular spline to involute flex gear in strain wave gearing**

- Describing a geometrical model of tooth meshing in strain wave gearing
- Effects of flex-gear geometry on conjugate profiles of circular spline

**Souta Doi**, Mechanical Engineering, Kyoto Institute of Technology, Japan

**Detection of surface damages by non-destructive micromagnetic methods**

- Influences of varying material conditions on the Barkhausen Noise
- Multiparameter approach for a more reliable measurement

**Prof. Dr.-Ing. habil. Prof. h. c. Dr. h. c. Dr. h. c. Bernhard Karpuschewski**, Managing Director, Manufacturing Technologies, Leibniz Institute for Materials Engineering, Bremen, Germany

**Use of multiple-body simulation during the gear unit development process**

- Optimal modelling depth for each phase of development
- Fully automated model generation allows for wide use of MBS

**Dipl.-Ing. Markus Lutz**, Development Engineer, Development Gear Units – Department Technical Acoustics, Dr.-Ing. Jörg Hermes, Managing Director, Innovation Mechanics, SEW-Eurodrive GmbH & Co. KG, Bruchsal, Germany

**Improving the estimation accuracy of fishing reel sensation caused by gear vibration using tactile response delay time**

- Estimation of tactile sensation only by inputting gear vibration waveforms
- Elucidation that "tactile response delay time" has a dependence on amplitude

**Tetsuo Inoue, Ph. D.**, Section Manager, Department of Reel Development/Fishing Operation Division, Shimano Inc., Sakai, Prof. Dr. Eng. Syuhei Kurokawa, Faculty of Engineering, Kyushu University, Fukuoka, Japan

**11:45 Load sharing model for high contact ratio spur gears with long profile modifications**

- New load sharing model considering tip relief and extended contact
- Optimization of load capacity with long profile modification

**Prof. Dr.-Ing. José I. Pedrero**, Full Professor, Dr.-Ing. Miguel Pleguezuelos, Associate Professor, Dr.-Ing. Miryam B. Sánchez, Associate Professor, Department of Mechanics, UNED, Madrid, Spain

**Ring gear tooth cracks detected using instantaneous angular speed: wind turbine application**

- Correction of the encoder geometric error to estimate IAS
- Comparison to classical vibration analysis

**Hugo Andre, Ph. D.**, Assistant Professor, Halil Ibrahim Cakar, Ph. D., Yasmine Hawwari, M. Sc., LASPI, Université Jean Monnet de Saint Etienne, Université de Lyon, Roanne, France

**Application of pre-calculated gear mesh stiffness on elastic gear bodies in multi-body simulation**

- Modelling strategy for elastic gear bodies in FE and MBS
- Optimisation for speed and accuracy for low to mid frequency ranges and NVH applications

**Faysal Andary, M. Sc.**, Research Scientist, Dr.-Ing. Joerg Berroth, Chief Engineer, Univ.-Prof. Dr.-Ing Georg Jacobs, Director, Institute for Machine Elements and Systems Engineering, RWTH Aachen University, Germany

**Creation of gear self-controlled variator**

- Tests of an adaptive gear variator and design correction
- Theoretical bases of creation of a serviceable gear adaptive variator

**Prof. Konstantin Ivanov**, Head of Group, Professor, Institute of Mechanics and Machine Science of Kazakhstan, Musin Alexey Alekseevich, doctoral candidate, Almaty University of Power Engineering and Telecommunication, Kazakhstan, Yaroslavl'tsev Elena Konstantinovna, senior lecturer, Cand.Tech. Sci., St. Petersburg University of Technology and Design, Russia

**12:15 A study on tooth profile modification of cycloid planetary gear drives with tooth number difference of two**

- A new design approach for flank modification of cycloid profile
- Influence of the flank modification on the contact characteristics

**Ling-Chiao Chang, M. Sc.**, Ph. D. student, Dr.-Ing. Shyi-Jeng Tsai, Associate Professor, Ching-Hao Huang, Ph. D. Candidate, Department of Mechanical Engineering, National Central University, Taoyuan City, Taiwan

**12:45 Research on dynamic drum shape modification of helical gear pair**

- The distributed meshing nonlinear dynamics model of the helical gear pair is established
- The drum shape modification method of helical gear pair is proposed

**Prof. Hui Liu**, Professor, Vehicle Research Center, Beijing Institute of Technology, Beijing, China

**Sensorless evaluation of the ideal timing for oil-change**

- Digital twin: Continuous oil-temperature calculation
- Ideal oil-changing time calculation

**Dipl.-Ing. Jan Lotz**, Calculation Engineer, Dr. Bernhard Bouché, Director of Research & Development, Dr. Reiko Thiele, Head of Calculation Department, Getriebebau NORD GmbH & Co. KG, Bargteheide, Germany

**Transferring knowledge about gear systems to machines in order to improve diagnosis efficiency**

- Geared systems diagnosis: gear fault, bearing fault, shaft fault
- Machine Learning: features engineering, features extraction

**Dr.-Ing. Alexandre Carbonelli**, Research Engineer, Numerical simulations, Vibratec, Ecully, France

**Analysis of manufacturing variability on the transmission error of an internal gear pair using a multibody framework**

- Assessment of manufacturing variability of the tooth topography on transmission error
- Validation of gear contact models in a multibody framework

**Ali Rezayat, Ph. D.**, Research Engineer, Siemens Industry Software N. V., Leuven, Belgium

**Robust force control of series elastic actuator using disturbance observer**

- Eliminate the effect of friction, backlash and torque ripple of series elastic actuator
- The solution for high performance force control is based on combinations of feedforward, PID, model-based, and DOB to address stability issues and improve force tracking accuracy

**Xing Du**, Student, Dr. Bingkui Chen, Professor, The State Key Laboratory of Mechanical Transmission, Chongqing University, Xiping Shan, Master, CEO, Hangzhou Seenpin Robot Technology Co. Ltd, China

**High speed driven tool for machine tools using magnetic transmission technology**

- Simulation of eddy-currents in magnets: 2d eddy current simulation, magnetic losses, high revolution speeds
- Reduction of eddy-currents in magnets: lamination, low losses, high efficiency

**Dr.-Ing. Stefan Vonderschmidt**, Managing Partner, Annika Ott, M. Sc., R&D engineer, Dipl.-Psych. Andreas Vonderschmidt, B. Sc., Managing Partner, Georgii Kobold GmbH & Co. KG, Horb, Germany

**Study on the contact characteristics of threaded surfaces in a planetary roller screw mechanism**

- Contact model and meshing characteristics of threaded surfaces
- Distribution of contact position and contact deformation

**Shangjun Ma, Ph. D.**, Associate researcher, School of mechanical engineering, Linping Wu, Master degree candidate, Project Team Member, Study on dynamics of planetary roller screw mechanism, Shaanxi Engineering Laboratory for Transmissions and Controls, Northwestern Polytechnical University, Xi'an, China

**13:15 Closing remarks**

**Closing remarks**

**Closing remarks**

**Closing remarks**

**13:30 Awarding of the best presentation for junior engineers in the main hall by the conference president**

**Prof. Dr.-Ing Karsten Stahl**, FZG, Technische Universität München (TUM), Garching, Germany

**Awarding of the best paper by**

**Dr.-Ing. Arbogast M. Grunau**, Principal Expert Bearings, Schaeffler Technologies AG & Co. KG, Herzogenaurach, Germany

+ Lunchtime snack

**15:00 End of the conference**

## Location/Venue

### International Conference on Gears 2019

Technische Universität München  
(Technical University of Munich)  
Institute of Machine Elements  
Gear Research Centre (FZG)  
Boltzmannstr. 15  
85748 Garching, Germany



### How to find us

Find all travel information at a glance!



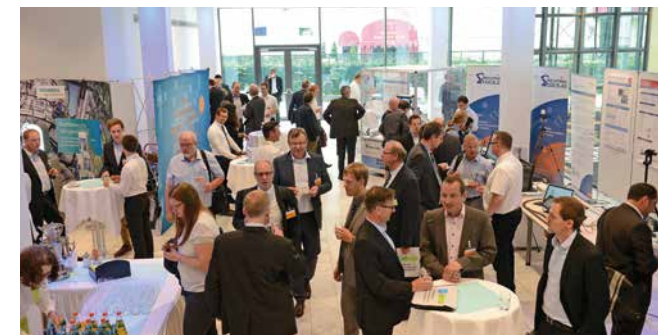


Combined with  
5-minute talks!

- **P1 Effect of installation errors on beveloid gears' precision ground by cone-shape worm wheel**  
**Bing Cao, B. Sc.**, Research Assistant, Chongqing University, China
- **P2 Evaluation method of measuring software based on virtual gear measuring center**  
**Prof. Chunxia Lu**, School of Mechatronic Engineering, Xi'an Technological University, China
- **P3 Index hobbing for asymmetrical gears**  
**Pierre Falbriard**, R&D Manager, Sales, Louis Bélet SA, Vendlin-court, Switzerland
- **P4 Micro-hobbing or when module below 0.1 becomes possible**  
**Pierre Falbriard**, R&D Manager, Sales, Louis Bélet SA, Vendlin-court, Switzerland
- **P5 Analysis of manufacturing costs for powder metallurgy (PM) gear manufacturing processes: a case study of a 4th drive gear**  
**Babak Kianian**, Ph. D. candidate, Department of Mechanical Engineering, Division of Production and Materials Engineering, Lund University, Sweden
- **P6 Visualization of phase differences between tooth helix deviations using graph theory**  
**Hidekatsu Noa**, Student, Mechanical Engineering, Kyoto Institute of Technology, Japan
- **P7 Proposal of linear mapping model among machining processes for gear tooth surface using graphic analysis**  
**Hiroki Noborio**, Student, Graduate School of Engineering, Tottori University, Japan
- **P8 Multisensory measurement of the base circle radius as a fundamental shape parameter of large gears**  
**Marc Pillarz, M. Sc.**, Research Assistant, Bremen Institute for Metrology, Automation and Quality Science, University of Bremen, Germany
- **P9 Measurement of gear racks with variable transmission ratio**  
**Dipl.-Math. Heinz Röhr**, Software Developer, Hexagon Metrology GmbH, Wetzlar, Germany
- **P10 An adaptive geometric meshing theory for face-milled generated spiral bevel gears**  
**Shenghui Wang**, Master student, Mechanical and Electrical Department, Central South University, Changsha, China

- **P11 A novel worm dressing approach for the manufacturing of face gear in a helical gear CNC grinding machine tool**  
**Wuji Zhang**, Master student, Mechanical and Electrical Department, Central South University, Changsha, China
- **P12 Design and analysis of Plastic PEK and PEEK spur gears with comparison under static load condition using FEA**  
**Vallabh Bhojar, B. Eng.**, Student Researcher, Mechanical Engineering, G.H. Raisoni College of Engineering, Nagpur, India
- **P13 Investigation on dynamic behavior of differential gearing with herringbone teeth**  
**Master Kun Liu**, Student, The State Key Laboratory of Mechanical Transmission, Chongqing University, China
- **P14 Vibration of thin rim spur gears with elastic foundation and discrete tangential stiffnesses**  
**Fuchun Yang**, Associate Professor, School of Mechanical Engineering, Shandong University, Jinan, China
- **P15 Increasing the bending strength of involute spur gear with an optimised hob tool**  
**Prof. Minggang Du**, Leader of technical innovation, Science and Technology on Vehicle Transmission Laboratory, China North Vehicle Research Institute, Beijing, China
- **P16 The analysis on grease lubrication at two tapered bodies contact considering surface roughness**  
**Zhenghai Wu, M. Sc.**, Ph. D. Postgraduates, School of Mechanical Engineering, Northwestern Polytechnical University, Xi'an, China
- **P17 2-stage gearbox optimization to minimize weight and maximize gear mesh efficiency considering the gear ratio for high speed gear**  
**Master Sanggon Moon**, Development Engineer, Department of Smart Industrial Machinery Mechanical Systems, Korea Institute of Machinery & Materials (KIMM), Daejeon, Korea
- **P18 Loaded tooth contact analysis of bevel gears with complex gear body**  
**Dipl.-Ing. Frederik Mieth**, Research Assistant, Chair of Machine Elements, Technical University of Dresden, Germany
- **P19 Geometric transmission precision analysis theory and experimental study on new type FT pin-cycloid reducer**  
**Liang Xuan, Ph. D.**, Associate Professor, University Teacher, School of Electromechanical and Architectural Engineering, Jiangnan University, Wuhan, China

- **P20 Mode shift process analysis and model predictive control strategy for electro-mechanical transmission system**  
**Dr. Qingdong Yan**, Professor, School of Mechanical Engineering, Beijing Institute of Technology, China
- **P21 Study of translational and torsional vibration distribution in two-stage planetary gears based on energy flow analysis**  
**Hongcai Li**, Associate Professor, Department of Vehicular Engineering, Beijing Institute of Technology, China
- **P22 Efficiency modelling and analysis for a novel double-arc bevel gear nutation transmission system for pure electric vehicles**  
**Nianhong Wan, Ph. D.** candidate, School of Mechanical Engineering and Automation, Fuzhou University, China
- **P23 An effective semi-analytical approach to predicting the surface contact temperature of the face gear drives**  
**Jun Wen**, Master student, Mechanical and Electrical Department, Central South University, Changsha, China
- **P24 Life extension for gearboxes through predictive maintenance**  
**Dipl.-Ing. Stefan Bill**, Managing Director, REWITEC GmbH, Lanau, Germany
- **P25 Test stand for internally cooled metal gears**  
**Dr.-Ing. Hans-Jörg Dennig**, Senior lecturer, School of Engineering, Zurich University of Applied Sciences, Winterthur, Switzerland
- **P26 Optimization of gearing induced noise emissions in railway applications by implementation of high gear profile**  
**Dipl.-Ing. Marek Kubis**, Head of gearbox design, Rolling Stock and Equipment – Drives, BOMBARDIER Transportation, Vienna, Austria



Free of charge  
for participants of GEARS 2019



## 3<sup>rd</sup> International Conference on Gear Production 2019

September 18-20, 2019, Garching/Munich, Germany



Source: WZL | Winandy

### Key topics:

- Novel manufacturing and measurement systems for gears
- Potentials in digital gear manufacturing
- Increasing productivity and flexibility in the production process
- Improving gear running and NVH behavior via manufacturing parameters
- Approaches for manufacturing-oriented gear design
- New solutions for modelling of gear manufacturing processes

### Presidency:

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

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

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

### With experts from:

ALD Vacuum Technologies GmbH | Central South University | Fraunhofer-Institute for Physical Measurement Techniques IPM | HAW Hamburg | Hefei University of Technology | Hexagon Metrology GmbH | Hirschvogel Automotive Group | JATCO Ltd. | Karlsruhe Institute of Technology (KIT) | KISSsoft AG | Louis Bélet SA | Mitsubishi Heavy Industries Europe Ltd. | OptoSurf GmbH | Otto-von-Guericke University Magdeburg | Physikalisch-Technische Bundesanstalt | Profilator GmbH & Co. KG | RWTH Aachen University | SEW-EURODRIVE GmbH & Co. KG | Small Innovation Enterprise "Mechanic" Ltd. | Technical University of Dresden | Technische Universität München (TUM) | University of Applied Sciences and Arts Hanover | University of Stuttgart | Werkzeugmaschinenfabrik Waldrich Coburg GmbH | Xi'an Technological University

Further details and the final program can be found here:

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

## 3<sup>rd</sup> International Conference on High Performance Plastic Gears 2019

September 18-19, 2019, Garching/Munich, Germany



Source: Technische Universität München (TUM)

### Key topics:

- Potentials for NVH improvements using plastic gears
- Novel tooth geometry and applications in various industries
- High-performance polymers for gears
- Analysis of thermo-elastohydrodynamic (TEHL) contacts of thermoplastic gears
- Methods for simulation and calculation of plastic gears

### Presidency:

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

### Conference Board:

**Dr.-Ing. Armin Kunz**, Senior Vice President, Chassis Systems Control, Project Modular Braking Systems, Robert Bosch GmbH, Abstatt, Germany

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

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

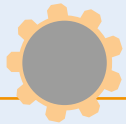
**Dipl.-Ing. Robert Seidler**, Vice President, Head of R&D, ZF Japan Co. Ltd., Japan

### With experts from:

Albis Plastic GmbH | Bauhar s.p. | Chair of Composite Engineering (CCE), Technische Universität Kaiserslautern | Chair of Industrial and Automotive Drivetrains, Ruhr-Universität Bochum | DSM Engineering Plastics B.V. | DuPont Specialty Products USA, LLC | Gear Research Centre (FZG), Technische Universität München (TUM) | IAVF Antriebstechnik GmbH | IMS Gear SE & Co. KGaA | Institute of Micro Technology and Medical Device Technology (MIMED), Technische Universität München (TUM) | Institute of Polymer Technology (LKT), University Erlangen-Nuernberg | KISSsoft AG | Kyoto Institute of Technology | Orbitless Drives Inc. | Robert Bosch GmbH | SABIC Innovative Plastic B.V. | University of Ljubljana | Victrex Europa GmbH | ZF Friedrichshafen AG | Zuerich University of Applied Sciences

Further details and the final program can be found here:

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



## GearLab

### 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! The following transmissions will be exhibited, stripped down into sub-assemblies:

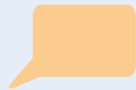
- Horst Scholz GmbH & Co. KG
- Schaeffler Automotive Buehl GmbH & Co. KG



## 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 and new core topics offer opportunities of gaining deeper insights into a variety of innovative gear test rigs and laboratory equipment. For registration meet at the FZG information desk during the conference.



## Speakers meet up

### Still have unresolved questions?

You can address your questions to the speakers right after the lecture during the coffee break. You will be able to meet them just in front of the lecture room. They will be available for at least 15 minutes.



## 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 in the Event App.



## Two gear community nights

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

Enjoy the evening reception at the Paulaner am Nockherberg as well as another social event on the second conference day at the university. The Paulaner am Nockherberg is one of the most traditional breweries in Munich and cradle of the Paulaner Brewery since 1627. Both – the get-together at the FZG and the brewery visit – offer you the opportunity to network with your peers and catch up on trends.





## Presidency



### Conference president

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



### Vice presidents

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



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



### Conference Board

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**Dipl.-Ing. Dirk-Olaf Leimann**, former Manager Gear Technology & Advanced Engineering, ZF Wind Power Antwerpen NV, Lommel, Belgium

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

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- Prof. Dr.-Ing. Michael Weigand**, Full Professor and Head of Institute IKL – Institute for Engineering Design and Logistics Engineering, Machine Design Division, Vienna University of Technology, Austria
- Prof. Dr. Changle Xiang**, Professor, Vice-President, Beijing Institute of Technology, Director, National Key Lab of Vehicle Transmission, China

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Make use of this full-service app for your visit of the International Conference on Gears 2019. You can not only plan your stay in Garching but also make use of the networking possibilities the app is offering you.

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

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### Your contact person:

Christoph Brockerhoff  
VDI Wissensforum GmbH  
VDI-Platz 1  
40468 Duesseldorf, Germany

Phone: +49 211 6214-228  
Fax: +49 211 6214-97228  
Email: brockerhoff@vdi.de

## List of exhibitors

(May 2019)

Applied Nano Surfaces GmbH  
Dassault Systemes Deutschland GmbH  
DuPont International Operations Sàrl  
Evonik Resource Efficiency GmbH  
Freudenberg Sealing Technologies GmbH & Co. KG  
GEORGII KOBOLD GmbH & Co. KG  
Giorgio Bonori Engineering  
Horst Scholz GmbH & Co. KG  
IMS Gear SE & Co. KGaA  
KISSsoft AG  
Metal Improvement Company Inc.  
Ovako AB  
Pulstec Industrial Co.,Ltd.  
SMT  
Stresstech GmbH

## The participants – Your customers

### Attendees in 2017

Experts:

46 %

Project manager:

25 %

Production engineer:

17 %

Project management:

7 %

Others:

5 %

### Function

Research and Development:

40 %

University/research institutions:

18 %

Construction and development:

17 %

Production:

9 %

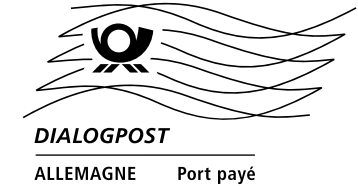
Sales:

9 %

Others:

7 %





Ticket includes entrance to parallel conferences:  
 • Gear Production 2019  
 • High Performance Plastic Gears 2019

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<input type="checkbox"/> Early bird price until June 21 <sup>st</sup> , 2019 EUR 1490.00	<input type="checkbox"/> From June 22 <sup>nd</sup> , 2019 EUR 1590.00

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**Venues:**  
**Conference:** Technische Universität München (Technical University of Munich), Institute of Machine Elements, Gear Research Centre (FZG), Boltzmannstr. 15, 85748 Garching, Germany, [www.fzg.mw.tum.de/en/fzg/contact/](http://www.fzg.mw.tum.de/en/fzg/contact/)  
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**Information:** The price includes conference documents (e-book), coffee breaks, and beverages during breaks, lunches and two evening receptions

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