

International Conference on Gear Production 2017

Parallel conferences
free of charge

Key topics discussed:

- Process optimization by digital gear manufacturing
- Future potential of PM gear technology
- Improved running behavior by manufacturing of functional surfaces
- New approaches for productivity increases and enhanced flexibility in gear manufacturing
- Advances in cylindrical gear production
- Manufacturing-related product properties

Presidency:

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

Prof. Dr.-Ing. Christian Brecher, WZL, RWTH Aachen, Germany

Prof. Dr.-Ing. Dr.-Ing. E.h. Dr. h.c. Dr. h.c. Fritz Klocke, WZL, RWTH Aachen, Germany

+ Parallel events

International Conference on High Performance Plastic Gears 2017

International Conference on Gears 2017

With experts from:

Applied Nano Surfaces Sweden | Daido steel | Gleason PFAUTER
 Maschinenfabrik | Höganäs | Involute Simulation Softwares | JATCO |
 KISSsoft | Klingelberg | Miba - High Tech Coatings | mimatic |
 SEW-Eurodrive | Stackpole International | ZF Friedrichshafen

Venue:



1st Conference Day
Wednesday, September 13th, 2017

● 08:30 **Registration**

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

- **International Conference on Gears 2017**
- **International Conference on High Performance Plastic Gears 2017**
- **International Conference on Gear Production 2017**

by

- **Prof. Dr.-Ing. Karsten Stahl**, FZG, Technische Universität München (TUM), Garching, Germany
- **Prof. i.R. Dr.-Ing. Bernd-Robert Höhn**, TUM emeritus of excellence, FZG, Technische Universität München (TUM), Garching, Germany
- **Dr.-Ing. Bernhard Bouché**, Director of Research and Development Mechanics, Getriebbau NORD GmbH & Co. KG, Bargteheide, Germany



Panel Discussion

● 09:45 **The future of gears - a high-tech product?**

"With modern gearing technologies, different materials and manufacturing processes can be combined for tailored gear design to meet the demands regarding cost, power density, NVH behavior and efficiency. The potentials and challenges of conventional gears, powder metal gears, plastic gears and gears cut on universal 5-axis CNC machines will be discussed by senior experts."

Moderation:

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

Participants:

"Why is conventional thinking and manufacturing paradigms preventing the widespread adoption of cost-effective powder-metal energy transfer solutions that minimize NVH and maximize efficiency and power density?"

Andrew Dempsey, Vice President – Powder Metal Division, Stackpole International, Ancaster, Canada

"Successful plastic gear gearbox applications provide significant reductions in noise, weight and cost while maintaining product performance. The optimization of the plastic gear tooth form is a critical factor in order to reach maximum performance."

George Diaz, General Manager, Gleason Plastic Gears, Rochester, New York, USA

"CnC machines offers flexibility and cost effectiveness in gear manufacturing. Like for dedicated machines, Closed Loop is essential, but should not be based on the "point cloud" method which normally requires an external Tooth Flank Generator."

Claude Gosselin Ph.D., P.Eng., President, Involute Simulation Softwares Inc., Quebec, Canada

"Tradition vs. progress – how can we match the potential of material, lube oil, calculation and machining with increasing emphasis on reliability, efficiency, light weight, and cost?"

Dr.-Ing. Burkhard Pinnekamp, Head of Central Technology, Renk AG, Augsburg, Germany

● 11:45 **Lunch break and visit to the exhibition and poster presentations**

● 13:00 **Welcome and opening of the Gear Production**

Prof. Dr.-Ing. Dr.-Ing. E.h. Dr. h.c. Dr. h.c. Fritz Klocke, Laboratory of Machine Tools (WZL), RWTH Aachen, Germany



Intelligent Gear Production

Moderation: Prof. Dr.-Ing. Dr.-Ing. E.h. Dr. h.c. Dr. h.c. Fritz Klocke, Laboratory of Machine Tools (WZL), RWTH Aachen, Germany

● 13:15 **Cyber physical gear production system**

- Vision of Industry 4.0 gear production
- Implementation of closed loop for cylindrical gears
- Calculation of digital twin
- Virtual process design is an enabler for silent gears

Dr.-Ing. Markus Brumm, Director Cylindrical Gear Division, Dr.-Ing. Hartmuth Müller, Head of Innovation and Technology, Klingelberg GmbH, Hückeswagen, Germany

● 13:45 **IoT and I4.0: electronic live tool integrated monitoring (eltimon)**

- Impact on process reliability, cost and quality through digitalization of live tools and other key components in gear cutting machines, milling and turning machines
- Preventive maintenance based on life-cycle relevant data
- On-the-spot data collection and analysis for the augmented operator
- A sensing solution, which can be used fully independent or in wireless connection with the eltimon cloud service

Dipl.-Ing. Karl-Heinz Schoppe, MBA, Head of Innovation + Marketing, mimatic GmbH, Betzigau, Germany

● 14:15 **Gear Data Exchange (GDE) – GoLive for digitalization**

- Digitalizing gear production by networking using standardized data transfer GDE
- Networking the gear production processes in order to increase productivity and process stability
- Presenting applications for digitalization using GDE in industrial practice

Dr.-Ing. Herman Yakaria, Advanced Expert Corporate Research & Development, Gear Manufacturing and Simulation, ZF Friedrichshafen AG, Germany

● 14:45 **Production cells in transition**

- Increasing factory productivity by changing standard production cells to high performance manufacturing systems
- Optimized tools and equipment for reducing cycle times and set-up times
- Use of digital technologies for improved performance of production cells
- Intelligent automation systems for realizing an enhanced material flow

Dipl.-Ing. Bernhard Winter, Department Manager Production Development, SEW-Eurodrive GmbH & Co KG, Graben-Neudorf, Germany



● 15:15 **Coffee break and visit to the exhibition and poster presentations**



Potential of Powder Metallurgy (PM) Process Chains

Moderation: Prof. Dr.-Ing. Dr.-Ing. E.h. Dr. h.c. Dr. h.c. Fritz Klocke, Laboratory of Machine Tools (WZL), RWTH Aachen, Germany

● 16:00 **Sustainability-conscious PM gear manufacturing: analysis of current manufacturing challenges**

- In-depth analysis and comparison of conventional and PM gear manufacturing value chains through the lens of sustainability
- Identification of three technical and four non-technical (managerial) barriers to PM adoption and deployment
- Discussion of existing solutions to remedy PM adoption barriers such as PM gear manufacturing concept and implementation readiness
- Recommendations for improving existing solutions to PM adoption hurdles

Babak Kianian, PhD Candidate, Prof. Carin Andersson, Professor, Department of Mechanical Engineering, Division of Production and Materials Engineering, Lund University, Sweden

16:30 Influence of contact conditions in cold rolling on the density profile of Powder Metallurgical (PM) gears

- Numerical analysis of contact conditions in the cold rolling of gears
- Determining the density profile of PM gears based on contact conditions in cold rolling
- Leading the density profile back to the stresses induced by the rolling process
- Modelling the density profile in the cold rolling of gears

Tim Frech M.Sc., Research Engineer, Manufacturing Technology, Gear Department, Prof. Fritz Klocke, Head of Department, Dr.-Ing. Dipl.-Wirt.-Ing. Christoph Löpenhaus, Chief Engineer, Gear Department, WZL, RWTH Aachen, Germany

17:00 PM gear rolling simulations using advanced plasticity material model and improved initial conditions

- Introduction to the powder metal manufacturing cycle for gears
- Introduction to secondary operations, benefits of gear rolling densification for PM gears
- Plasticity material models for porous materials and gear rolling simulations
- Experimental process, results and validation with gear rolling simulations

Vasilis Angelopoulos M.Sc., Development Engineer, Powder Metal Components (PMC), Höganäs AB, Sweden, Dipl.-Ing. Michael Hirsch, Project Engineer, Pre-development Department, Profiroll Technologies GmbH, Bad Dübén, Germany

17:30 PM technology for the future powertrain

- Process chain of PM: material, heat treatment and finishing
- Durability as a function of the PM process chain
- Heat treatment distortions in comparison to conventional gear manufacturing
- Design for PM: design study of the future electric powertrain

Dr.-Ing. Philipp Kauffmann, Research and Innovation Manager, Dipl.-Ing. Philipp Schäflein, Business Development Manager, Stackpole International, Aachen, Dr. Volker Heuer, Director R & D Vacuum Heat Treatment, ALD Vacuum Technologies GmbH, Hanau, Germany

18:15 Organized bus transfer to the evening reception



Get-together

19:00 Evening reception at the „Hofbräuhaus München“

At the end of the first conference day we cordially invite you to our evening reception at the „Hofbräuhaus München“, a traditional Bavarian brewery with deep roots in Munich.



Source: BBMC Tobias Ranzinger

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

Dinner Speech

Dipl.-Ing. Oliver Zipse, Member of the Board of Management, Production, BMW AG, Munich, Germany

2nd Conference Day

Thursday, September 14th, 2017



Manufacturing Related Product Properties

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

08:30 Multi-component gearwheels and their manufacturing processes

- Intelligent lightweight design for multi-component gearwheels
- Laterally extruded wheel body
- Stapled sheet metal wheel body
- Numerical forming and structural analysis

Robert Meißner M.Sc., Research Assistant, Bulk Metal Forming, Institute for Metal Forming Technology, University of Stuttgart, Dipl.-Ing. Tim Benkert, Research Assistant, Institute of Metal Forming and Casting (utg), Technische Universität München (TUM), Garching, Germany

09:00 A procedure to find best fitting dresser with grinding worm for a new design

- Geometrical definition with basic equations
- Calculation of profile modifications based on the geometry of the dresser and grinding wheel
- Reshaping the grinding worm with the dresser
- Manufacturing gears using existing grinding worms

Dr.-Ing. Michael Franz Stangl, Senior Software Engineer, KISSsys Software development, Dr. Aljaz Pogacnik, Software Engineer, Dr.-Ing. Ulrich Kissling, CEO, KISSsoft AG, Bubikon, Switzerland

09:30 Flank modifications for optimal excitation behaviour

- Low-noise mesh without compromised load carrying capacity
- Separation of design steps for statics and dynamics
- Direct compensation for transmission error
- Improved manufacturability compared to pure waveform

Dipl.-Ing. Bernhard Kohn, Dipl.-Ing. Thanak Utakapan, Dipl.-Ing. Maximilian Fromberger, all Scientific Employee, Gear Dynamics, Gear Research Centre (FZG), Technische Universität München (TUM), Garching, Germany



10:00 Coffee break and visit to the exhibition and poster presentations



Advances in Cylindrical Gear Production

Moderation: Dr.-Ing. Joachim Thomas, Managing Director, ZG Hypoid GmbH, Eching, Germany

10:45 Accuracy analysis of workpiece and tool in the hobbing process using the Taguchi Method

- Analysis of the most important control factors in work/hob run-outs, tool specifications and hobbing conditions
- Hobbing simulation to analyze the relationship between workpiece/tool positions
- Effect of workpiece/tool positioning accuracy on the accuracy of gear hobbing
- Reducing manufacturing costs by eliminating shaving process in gear honing finish

Dipl.-Ing. Kouji Matsuo, Development Engineer, Hardware system Development, Dr.-Ing. Yoshitomo Suzuki, Engineering Management, Kenichi Fujiki, Parts Process Engineering, JATCO Ltd, Kanagawa, Japan

11:15 CnC manufacturing of circular faced cylindrical gears

- Design of cylindrical gears generated by a face-mill cutter
- Study of the contact and comparison with standard spur gears
- Investigation of the sensitivity to installation errors and comparison with standard spur gears
- Manufacturing on a multi-axis CnC machine, CMM measurement, testing of the actual contact pattern and comparison with the design

Claude Gosselin Ph.D., P.Eng., President, Involute Simulation Softwares Inc., Quebec, Canada, Eberhard Fritz, Manager – Product Development, ESA Eppinger GmbH, Denkendorf, Germany

11:45 Grinding or shaving? - Performance-based economic decision support in the manufacturing of gears

- Presentation of performance-driven manufacturing cost model
- Discussion on important cost drivers and development of decision support in production development
- Application to performance-driven cost analysis in decision on finishing operation in gear manufacturing at a heavy vehicle manufacturer
- Cost comparison between shaving and grinding

Prof. Carin Andersson, Professor, Division of Production and Materials Engineering, Lund University, Sweden

12:15 Approaches to modelling grinding worm wear

- Grinding tool wear: corundum, vitrified bond, generating gear grinding
- Energetic approach to wear prediction
- Optimization of generating gear grinding
- Tribology of grinding process

Dipl.-Ing. Matthias Opehy, Research Assistant, Prof. Fritz Klocke, Head of Department, Dr.-Ing. Dipl.-Wirt.-Ing. Christoph Löpenhaus, Chief Engineer, Gear Department, WZL, RWTH Aachen, Germany

12:45 Lunch break and visit to the exhibition and poster presentations



Advances in Bevel Gear Production

Moderation: Prof. Dr.-Ing. Christian Brecher, Laboratory of Machine Tools (WZL), RWTH Aachen, Germany

14:15 Contact pattern control with simple cutter motion in face-milling of Zerol bevel gears using 5-axis machine

- Computer simulation for face milling of bevel gears
- Face milling of Zerol gears with a simple cutter motion
- Calculations of transmission errors, contact patterns and backlashes
- Intuitive control of contact pattern with simple machine settings modification

Prof. Dr. Eng. Ichiro Moriwaki, Professor, Dr. Daisuke Iba, Associate Professor, Mechanical Engineering, Ryosuke Kikuchi, former Graduate Student, Kyoto Institute of Technology, Japan

14:45 Surface structure shift for ground bevel gears

- Impact of structure, waviness on harmonic excitations
- Tool to introduce a targeted surface structure by adding micromotions
- Correlation of the objected harmonic to its surface structure
- Making the overall noise level more acceptable

Dipl.-Ing. Eyüp Böyükbas, Senior Application and Process Engineer Bevel Gears, Bevel Gear Application, Gleason PFAUTER Maschinenfabrik GmbH, Ludwigsburg, Germany, Prof. Dr.-Ing. Hermann J. Stadtfeld, Vice President, Sebastian Strunk M.Sc., Gear Theoretician R&D Bevel Gear, The Gleason Works, Gleason Corporation, Rochester New York, USA

15:15 Experimental studies and simulation of hypoid gear lapping

- High-resolution measurement of wear depth in hypoid lapping
- Adaption of Archard's wear equation to hypoid gear contact
- Simulation by temporal discretization and TCA
- Comparison of results

Dipl.-Ing. Felix Rudolph, Research Assistant, Faculty of Mechanical Science and Engineering, Prof. Dr.-Ing. Berthold Schlecht, Dr.-Ing. Stefan Schumann, Institute of Machine Elements and Machine Construction, Technische Universität Dresden, Germany

15:45 Coffee break and visit to the exhibition and poster presentations



Innovative Materials and Treatments

Moderation: Prof. Dr.-Ing. Christian Brecher, Laboratory of Machine Tools (WZL), RWTH Aachen, Germany

16:30 Effect of alloying elements on edge-part over-carburizing in vacuum carburizing

- The surface carbon content after vacuum carburizing increased with the sharpness of the corner
- Coarse carbides occurred at the corner in high Cr-low Si steel, resulting in lower fatigue strength
- On the other hand, no carbides occurred in low Cr-high Si steel
- Low Cr-high Si steel kept high fatigue strength without depending on the edge angle of the specimens

Kenta Tsujii M.Eng., Research Engineer, Yuuki Tanaka Dr.-Eng., Associate Senior Research Engineer, Ryohei Ishikura M.Eng., Senior Research Engineer, Automotive steel research sect.No1, Special steel lab., Corporate Research & Development Center, Daido steel co. LTD, Nagoya, Japan

17:00 Influence of the grinding process on the formation of boundary layers on gears

- Profile gear grinding: case-hardened steel, corundum grinding wheel, mineral grinding oil
- Variation of feed rate and infeed
- Investigation of surface roughness, residual stresses and micro structure
- Boundary layer analysis by means of FIB-SEM

René Greschert M.Sc., Research Engineer, Research Group Gear Testing, Prof. Dr.-Ing. Christian Brecher, Head of Chair of Machine Tools, Dr.-Ing. Dipl.-Wirt.-Ing. Christoph Löpenhaus, Chief Engineer, Gear Department, WZL, RWTH Aachen, Germany

17:30 Adaptive coating on gears for NVH improvement

- Introduction to adaptive coatings on gears – ideas behind this
- Advantages from selected coating technology
- Optimization of mechanical properties for different applications
- NVH improvements achieved in gear drives

Günter Eitzinger, Head of Advanced Engineering, Miba - High Tech Coatings GmbH, Vorchdorf, Austria

18:00 An advanced thermal processing and coating process for enhancing gear tribology

- An innovative thermal processing and coating technology jointly developed by ANS and Bodycote
- Case-hardened surface with drastically improved tribological performance
- Superior resistance to wear, fatigue, pitting
- Up to 2x higher scuffing barrier compared with regular case-hardened gears

Prof. Dr. Boris Zhmud, CTO-Chief Technology Officer, Dipl. Eng. Johan Blomkvist, Development Engineer, Applied Nano Surfaces Sweden AB, Uppsala, Dipl. Eng. Mikael Fallstrom, VD, Bodycote Värmebehandling AB, Älvsjö, Sweden



Get-together

- 18:30 At the end of the second conference day we kindly invite you to our evening reception. Enhance your personal network and use the relaxed and informal atmosphere for deepening talks with other participants and speakers.

Dinner Speech

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



+ stay another day:
"Visit free of charge the third day of the
"International Conference on Gears 2017"
on September 15th – www.vdi-gears.eu

Presidency



from left to right

Prof. Dr.-Ing. Karsten Stahl, Full Professor, Institute of Machine Elements, Director, Gear Research Centre (FZG), Technische Universität München (TUM), Garching, 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. Dr.-Ing. E.h. Dr. h.c. Dr. h.c. Fritz Klocke, Full Professor, Chair of Manufacturing Technology, Laboratory for Machine Tools and Production Engineering (WZL), Faculty for Mechanical Engineering, RWTH Aachen University, Germany

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www.vdi.eu

Parallel Conference

Visit for free!

International Conference on High Performance Plastic Gears 2017

September 13-14, 2017

Key topics discussed:

- Novel precision plastic gear applications in various industries
- Characterization of thermo-elastohydrodynamically lubricated (TEHL) contacts of thermoplastic gears
- Design investigations and indications for acoustically optimized gear meshing using plastic gears
- High performance polymers for future tribological application

Presidency:

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

Prof. Dr.-Ing. Dietmar Drummer, University Professor, Institute of Polymer Technology (LKT), Friedrich-Alexander Universität Erlangen-Nürnberg, Erlangen, Germany

With experts from:

Bühler Motor | DSM Engineering Plastics Research & Technology | DuPont | Evonik Resource Efficiency | Gleason Plastic Gears | Horst Scholz | IMS Gear | KISSsoft | Klüber Lubrication München | Robert Bosch | Sabic | Victrex Europa | ZF Friedrichshafen

Further details and the final program can be found here:

www.vdi.de/plasticgears

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Parallel Conference

Visit for free!

International Conference on Gears 2017

September 13-15, 2017

Key topics discussed:

- Design, analysis, geometry and simulation of gears and transmissions
- NVH behavior and noise reduction of transmission systems
- New materials, lubrication and coatings for higher durability of gears
- New test methods and procedures for service life, efficiency or predictive maintenance

Presidency:

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

Dr.-Ing. Bernhard Bouché, Director of Research and Development Mechanics, Getriebbau 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

With experts from:

ABB | AKGears | DriveConcepts | ESI ITI | Georgii Kobold | GKN Sinter Metals Engineering | Gleason Plastic Gears | Harmonic Drive Systems | Involute Simulation Softwares | imq | JATCO | JR Dynamics | KISSsoft | Orbitless Drives | Ovako | REM Surface Engineering | Renk | Rolls-Royce Deutschland | Romax Technology | SEW-Eurodrive | Siemens | Sintex | Sumitomo Heavy Industries | Stackpole International | SwePart Transmission | Toyota Central R&D Labs. | Turkish Aerospace Industries | VibraTec | Voith Turbo | Wittenstein | ZF Industrieantriebe Witten | ZG Hypoid

Further details and the final program can be found here:

www.vdi-gears.eu

International Conference on Gear Production 2017

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<input type="checkbox"/>	September 13th – 14th, 2017 in Garching/Munich, Germany (02TA411017)
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Venue/Accommodation:

Conference Venue: 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

Hotel Reservation:

For booking please visit www.vdi.de/gearproduction where you find a link for special room rates.

Hotels close to the conference venue may be found via our HRS service www.vdi-wissensforum.de/hrs



Services: VDI Wissensforum service package: The conference package includes the conference documents (VDI-Bericht), coffee-breaks, beverages, lunch and evening events.

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