3rd International Conference on High Performance Plastic Gears 2019

Key topics discussed:

- 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

With experts from:

Parallel conferences free of charge

Parallel events
International Conference on Gears 2019
International Conference on Gear Production 2019

Exhibition

Veranstaltung der VDI Wissensforum GmbH
www.vdi-wissensforum.de/plasticgears
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#VDI_Gears

September 18 - 19, 2019, Garching/Munich, Germany
**1st Conference day**

**Wednesday, September 18th, 2019**

**08:30** Registration

**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

by 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. Arborgast 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

**10:00** Keynote session:
From system to atom – digital twin 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. Arborgast 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

Professor 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

Atomicistic simulations in tribology: potentials, perspectives and limitations
- Tribological processes hidden at buried interfaces
- Evolution of materials structure and chemistry under tribological load
- 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 working lunch – meet & greet at the exhibition area, poster presentation area and GearLab

**13:15** Comparison of strength rating of plastic gears by VDI 2736 and JIS B 1759 – in vision of building a new international standard
- Comparison of calculation methods
- Calculation of bending load capacity of plastic gears
- Difficulties and obstacles in establishing a global consensus on the calculation method for plastic gears

Inho Bae, Ph.D., Head of Technical Support, Dr.-Ing. Ulrich Kissling, President, KISSsoft AG, Bubikon, Switzerland

**13:45** Thermoplastic high performance composite gears
- Gears made of PEEK and endless carbon fibers
- Testing plastic gears according to VDI2736 size 2
- Gear production: composite flow moulding vs. milling

Dr.-Ing. Hans-Jörg Dennig, Senior Lecturer, School of Engineering, Severino Monn, B. Sc., scientific assistant, Centre for Product and Process development, Zurich University of Applied Sciences, Winterthur,
Dr.-Ing. Albert Vodermayer, Portfolio Manager Industry, icotec AG, Altstätten, Switzerland

**14:15** Tooth flank load capacity

Moderation: Dipl.-Ing. Robert Seidler, ZF Japan Co., Ltd.

**14:45** Insight into the world of plastic gears

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

**16:00** Flank load carrying capacity of oil-lubricated high performance plastic gears – analysis of the pitting development in back-to-back tests
- Back-to-back tests with a steel-plastic pairing
- Analysis of flank load carrying capacity acc. to VDI 2736
- Evaluation of pitting performance

Christopher Martin Illenberger, M. Sc., Research Assistant, Gear Research Centre (FZG), Institute of Machine Elements, Technische Universität München (TUM), Garching, Germany

**www.vdi-wissensforum.de/plasticgears**
2nd Conference day  
Thursday, September 19th, 2019

**Strength evaluation**  
Moderation: Dr.-Ing. Ulrich Kissling, Kisssoft AG, Switzerland

08:30 Extension of the application limits for crossed helical gearboxes by new geometries for smaller sliding paths or smaller contact pressures  
- New method for the geometry analysis of crossed helical gears  
- Optimization of Hertzian pressures or sliding paths  
- Optimization of excitations characteristics

Christoph Boehme, M. Sc., Research Assistant, Dr.-Ing. Dietmar Vill, Post-doc/Senior engineer, Prof. Dr.-Ing. Peter Tenberge, Full Professor, Chair of Industrial and Automotive Drivetrains, Ruhr-University Bochum, Germany

09:00 Comparison between VDI 2736 wear calculation and experimentally obtained results  
- Polymer gear wear measurement and theoretical wear factor  
- Wear comparison with pin-on-disc results  
- Wear simulation using loaded tooth contact analysis

Sebastjan Matkovic, M. Sc., Research Assistant, Prof. Dr. Mitjan Kalin, Professor, Head of the Lab, Laboratory for Tribology and Interface Nanotechnology, Faculty of Mechanical Engineering, University of Ljubljana; Dr. Aljaž Pogačnik, CEO, Bauhar s.p., Bled, Slovenia

09:30 Predicting wear for high performance plastic gears  
- Wear measurements on a relevant tribological set-up relevant to plastic gears  
- Prediction of wear by combining numerical and analytical tools  
- Validation on measured wear on plastic gears experimentally accessed on a gear tester

Benjamin van Wissen, M. Sc., Design Engineer/Associate Scientist, Dr. ir. Marc Kanters, Scientist, Polymer mechanics, fatigue, failure, strength, Adnan Hasanovic, M. Sc., System Expert Gears and Actuators, DSM Engineering Plastics B.V., Geleen, The Netherlands

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

10:45 Material data for advanced plastic gear simulation  
- Thermoplastic materials for gears  
- Material data characterization for gear simulation  
- Plastic-plastic spur gear wear simulation

Julien Cathelin, Ph.D., Sr. Scientist, Application technology, SABIC Innovative Plastic B.V., Geleen, The Netherlands

11:15 Bespoke plastic compounds for plastic gears  
- Requirements on thermoplastic materials  
- Overview of suitable plastics and their modifications  
- Proactive material selection and part design


11:45 Advances in polyacetal materials for gears  
- Dynamic lifetimes of polyacetals at controlled temperature testing  
- Modeling of gear deformation behavior  
- Formulations to improve processability and performance of polyacetals in gears

Ram Ratnagiri, Ph.D., Engineer, R&D, Transportation & Advanced Polymers, DuPont Specialty Products USA, LLC, Wilmington, USA; Dipl.-Ing. Hans Kuchelka, Technical and Development Specialist, Transportation and Advanced Polymers, DuPont de Nemours (Deutschland) GmbH, Neu-Isenburg, Germany; Makoto Kato, Ph.D., Staff Research Chemist, Transportation and Advanced Polymers, DuPont Kabushiki Kaisha, Utsunomiya, Japan
12:15 Investigation of radiation crosslinking as performance enhancement for thermoplastic spur gears
• Material modification polymer spur gears
• External and internal modification of polymer matrix
• Tribological behavior and possible applications
Dipl.-Ing. Bernhard Gierl, Project Engineer, Tribology, Prof. Dr.-Ing. Dietmar Drummer, University Professor, Institute of Polymer Technology (LKT), University Erlangen-Nuremberg, Erlangen, Germany

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

13:15 Powertrain NVH improvement with high performance polymer gears
• Market trends and customer needs
• Polymer gear design concept and benefits
• Concept validation with durability and NVH testing
Dipl.-Ing. Ralf Weidig, Global Program Manager Gears, Automotive Business Unit, Victrex Europa GmbH, Hofheim; Dr.-Ing. Hans Joachim Weimar, Manager Engineering Services, IAV Antriebstechnik GmbH, Karlruhe, Germany

14:15 Improvement of the noise and vibration behavior of an electromechanical brake booster – an integral approach
• High performance plastic gears in innovative brake systems
• Optimization strategies to improve noise and vibration
• Correlation of simulation and test on the component and system levels
Dr.-Ing. Jens Fechler, Director R&D, R&D Actuators, Dipl.-Ing. (FH) Michael Knopfle, Project Engineer/R&D Components, Volker Merz, B. Eng., NVH Engineer/R&D Actuators, IMS Gear SE & Co. KGaA, Donaueschingen, Germany

14:45 Crack detection of plastic gears using a convolutional neural network pre-learned from images of meshing vibration data with transfer learning
• Visualisation of grey-scale images from vibration signals using FFT
• Contraction of a CNN based on VGG16 with transfer learning
• Detection crack or non-crack situation of plastic POM gears
Bui Huy Kien, Doctoral Course Student, Mechanical Engineering, Kyoto Institute of Technology, Japan

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

15:45 Simulation tool-chain for plastic gear design
• Gear design and material selection
• Stress/strain calculation and fatigue analysis
• Tribology simulation
Dipl.-Ing. Martin Uhlig, Development Engineer Gear Design, Engineering Components Actuation, Robert Bosch GmbH, Abstatt; Dr.-Ing. César Pastor, Research Engineer, Contact Dynamics and Tribology, Robert Bosch GmbH, Renningen, Germany

16:30 Simulation tool-chain for plastic gear design
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Dipl.-Ing. Martin Uhlig, Development Engineer Gear Design, Engineering Components Actuation, Robert Bosch GmbH, Abstatt; Dr.-Ing. César Pastor, Research Engineer, Contact Dynamics and Tribology, Robert Bosch GmbH, Renningen, Germany

17:00 Layout of profile modifications for symmetric and asymmetric plastic gears
• Plastic gear design: root and flanks strength, wear optimization
• Transmission error optimization
• Contact analysis of symmetric and asymmetric gears
Dr.-Ing. Aljaž Pogačnik, Plastic Gear Consultant, Bauhar s.p., Bled, Slovenia; Dr.-Ing. Ulrich Kissling, President, KISSsoft AG, Bubikon, Switzerland

17:30 Multi-criteria polymer gears design optimization procedure
• Reliable dimensioning of polymer gears
• An overview of parameters influencing the target criteria
• Torque transfer function in the smallest volume
Assoc. Prof. Dr. Jože Tavčar, Laboratory for Engineering Design LECAD, Damijan Zorko, M. Sc., Researcher, Prof. Dr. Jože Dužovnik, Full Professor, Head of LECAD Group, Laboratory, Chair for Design and Transport systems, Faculty of Mechanical Engineering, University of Ljubljana, Slovenia

18:00 Complementary strengths of orbitless and planetary drives
• Review of the known properties of different drive configurations
• Discovering noise and vibration characteristics using simulation X
• Prototypes built to exploit both sets of strengths
Leo Stocco, Ph.D., P.Eng., Managing Director/CEO, Orbitless Drives Inc., Vancouver, Canada

18:30 End of the conference

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

+ Stay another day – September 20, 2019:
Visit free of charge the third day of the parallel conferences:
• International Conference on Gear Production 2019
  September 18 - 20, 2019, Garching/Munich, Germany
  www.vdi-wissensforum.de/gearproduction
• International Conference on Gears 2019
  September 18 - 20, 2019, Garching/Munich, Germany
  www.vdi-gears.de
The conference will give you the answers to these questions:

- Plastic gears – a possible alternative to metal gears?
- What are the actual methods for the simulation and calculation of plastic gears?
- How can the durability of plastic gears be improved?
- What’s the potential for improving NVH behavior by using 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

Highly committed and with a great passion to succeed, the program committee – consisting of the following experts – draws up the conference agenda for you.

from left to right:
Dr.-Ing. Ulrich Kissling, President, KISSsoft AG, Bubikon, Switzerland
Dr.-Ing. Armin Kunz, Senior Vice President, Chassis Systems Control, Project Modular Braking Systems, Robert Bosch GmbH, Abstatt, Germany
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.

Scientific support:

VDI Society Product and Process Design

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

www.vdi.eu

Exhibition & sponsorship

Would you like to get face to face with the high-powered delegates attending this VDI conference and present your products and services to a specialist sector of your market?

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

Your contact person:
Christoph Brockerhoff
Phone: +49 211 6214-228
Fax: +49 211 6214-97228
Email: brockerhoff@vdi.de

List of exhibitors

- 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.
- Smart Manufacturing Technology, Ltd.
- Stresstech GmbH

(May 2019)
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.

Venue:

Source: Scharger, Albert/TUM
Parallel conferences

3rd International Conference on Gear Production 2019
September 18 - 20, 2019, Garching/Munich, Germany

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

The conference will give you the answers to these questions:
• What are demands and solutions for intelligent gear production?
• How do optical measurement systems contribute to full-scale inspection?
• Which potentials are in optimization of functional surface in gear manufacturing?
• How can productivity of gear manufacturing processes be increased?
• What are the right application cases for upcoming technologies such as skiving?

Further details and the final program can be found here:
www.vdi-wissensforum.de/gearproduction

Parallel conferences

International Conference on Gears 2019
September 18 - 20, 2019, Garching/Munich, Germany

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

Presidency:
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
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:

The conference will give you the answers to these questions:
• Where are the potentials for innovative tooth geometry and modifications?
• How can you increase the load carrying-capacity?
• What are the best techniques for continuous diagnosis and monitoring?
• Are there new methods to simulate and calculate gears and transmissions?
• What are the effects of lubrication and elastohydrodynamic lubrication?

Further details and the final program can be found here:
www.vdi-gears.eu
Please register for (price per person plus VAT):

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<th>First Name</th>
<th>Last Name (Family Name)</th>
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Participants with an invoice address outside of Austria, Germany and Switzerland are kindly requested to pay by credit card. Please don’t send your credit card details via email, fax or post. Please book your ticket at www.vdi-wissensforum.de/plasticgears. Transferring your credit card details via our website ensures your details are encrypted and security of your data is guaranteed.

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Venue:
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/
Hotel reservation: A limited number of rooms have been reserved for conference participants. For booking please visit www.vdi-wissensforum.de/plasticgears where you find a link for special room rates.

Participation fee for personal VDI-members and members of associated organisations of the “International Conference on Gears 2019” save 50 € each conference day

VDI membership no. *: ___________________

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

I'm interested in sponsoring and/or the exhibition.

Opportunities, chances and limits of plastic gears application

You need help? Please contact us!

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September 18–19, 2019,
Garching near Munich, Germany
(02TA409019)

☐ Early bird price until June 21st, 2019
EUR 1490.00

☐ From June 22nd, 2019
EUR 1590.00

www.vdi-wissensforum.de/plasticgears