Polish Honing of Gears - Potentials and Technological Challenges

Presenter:

Maximilian Schrank
WZL of the RWTH Aachen University

Additional Authors:
Dr.-Ing. Mareike Solf and Prof. Dr.-Ing. Thomas Bergs
WZL of the RWTH Aachen University

Gear honing is an established process for hard finishing of small and medium-sized gears with a module of $m_n \leq 5$ mm. Due to its low-noise surface structure and economic efficiency in series production, gear honing has become particularly popular in the automotive industry. As a result of the increasing electrification of powertrains, efforts are being made to manufacture low-noise gears with a high efficiency and high load-carrying capacity. To increase the load-carrying capacity, the tooth flank roughness needs to be low. In order to produce very fine surfaces, gears are increasingly being polish-ground with elastic bond systems after conventional grinding. When using elastically bonded grinding tools, it has been shown that the process setup is challenging and the corrections during dressing must be determined iteratively. In the gear honing dressing process using a dressing gear, profile corrections in particular cannot be cost-effectively determined using an iterative procedure.

As a result, investigations on the polish gear honing process regarding the elastic deformation of honing rings are made. An existing honing force model is used to model the process force induced honing ring deformation. In combination with a honing ring model based on incremental elements, the elastic local honing ring deformation can be calculated using HOOKE's law. Based on the local deformation of the honing ring elements, a resulting profile angle deviation along the face width can be calculated. Dressing and gear honing trials were performed to determine the deviation of the honing ring after dressing and of the gear after honing. The results of the trials, the deviations calculated with the model could be confirmed qualitatively. Additional to the investigations on the honing ring deformation and the resulting gear geometry, investigations on the resulting surfaces are made. A high potential to reduce surface roughness by polish gear honing can be demonstrated. The resulting roughness is comparable to the roughness after polish gear grinding. A resulting surface roughness of Rz < 0,9 µm has been achieved. Since polish honing process is not an established process, it is assumed that lower surface roughness will be achieved in the future.

In the future, the deformation model needs to be modified and extended. The modifications to the model have to be made to take into account the material model of the honing ring specification used in the polish honing trials. The deformation model has to be extended to consider the deformation of the honing ring in the calculation of the local force. Furthermore, the interaction between the deformation of the honing ring during the dressing process and the gear honing process has to be considered in both, simulation and trials. By better understanding and modeling the deformation behavior of elastically bonded honing rings, honing and dressing processes can be designed more productively and economically to achieve even higher surface finishes in the future.

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Author and Speaker: **Maximilian Schrank M.Sc.**
Co-Authors: Prof. Dr.-Ing. Thomas Bergs, Dr.-Ing. Mareike Davidovic

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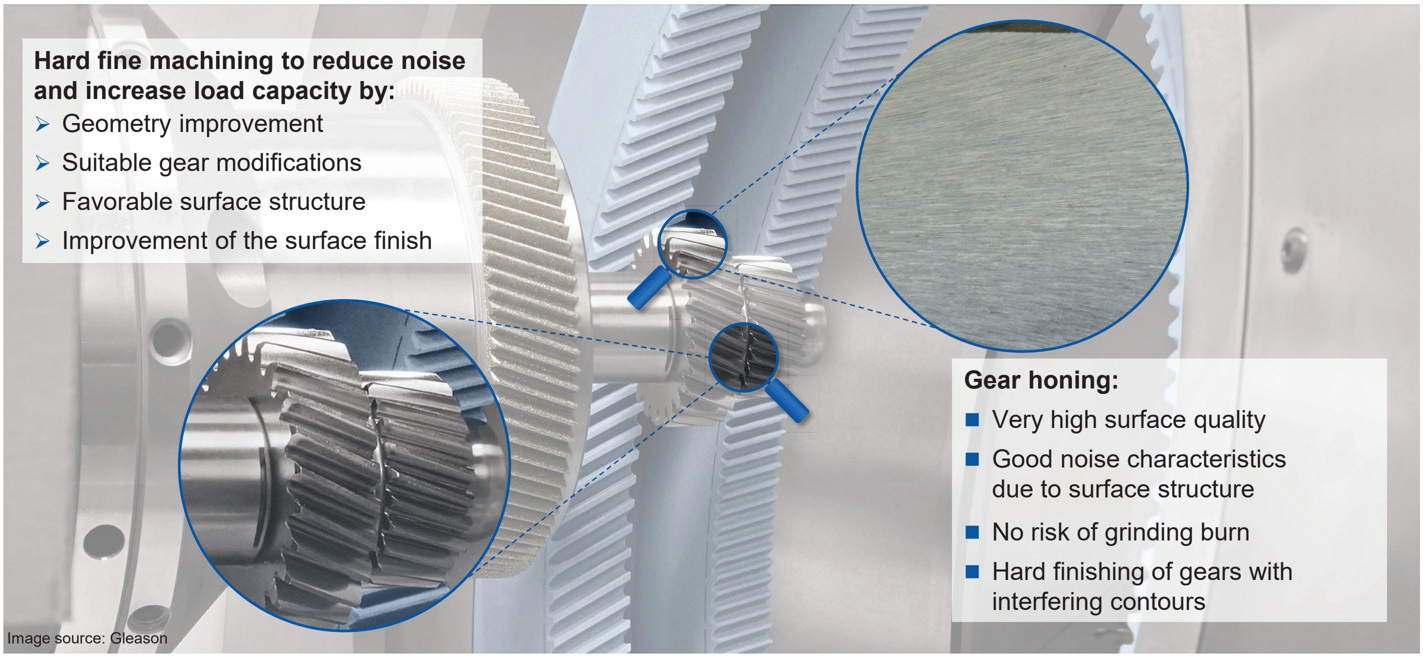
Introduction and motivation
Reasons for hard fine machining of gears by gear honing



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