

Skiving: Precision and Comfort Throughout the Process Chain



Engineering instead of trial and error: PTM is a powerful software tool for designing complex tool geometries and performing feasibility analyses on the basis of process simulations. 3D visualization of workpieces, tools and process kinematics provides lucid understanding of the complexities of tool design and process parameterization.

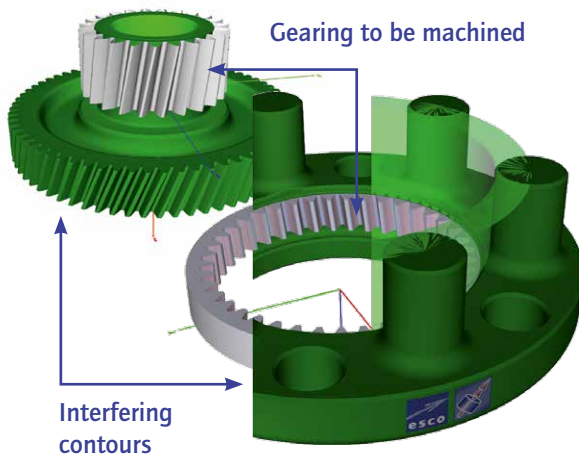
Fundamentals of skiving wheel design

The efficient design and manufacture of high-quality skiving wheels pose formidable challenges to development, production engineering and quality assurance. High-performance software tools that comprehensively cover these fields are vital necessities. This is where PTM comes in. Constituting a virtual machine tool of modular design, combined with the 3D visualizing tool EVA4D, it fully meets the requirements of simulating the essential process kinematics: skiving itself as well as profile

and discontinuous generation grinding to produce the skiving wheels. At the focus of PTM are feasibility analyses, tool design and optimization, plus the indispensable EVA4D accessory for

- analyzing the marginal conditions for skiving with regard to clearance angle situation and path of contact at the spatial position of the cutting edge;
- analysis of potential collisions with interfering contours in skiving the gear.

EVA4D also doubles as a 3D geometry interface.



1 Examples of interfering contours having a significant influence on skiving wheel design, read into EVA4D from CAD systems or generated in PTM as a rotational geometry.

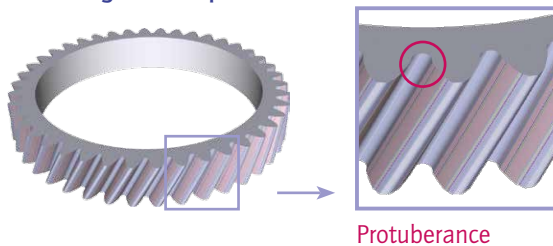
The picture in the middle of the opposite page illustrates the virtual skiving machine on which PTM is based. The influencing variables listed determine the geometry of a skiving wheel.

Range of workpieces

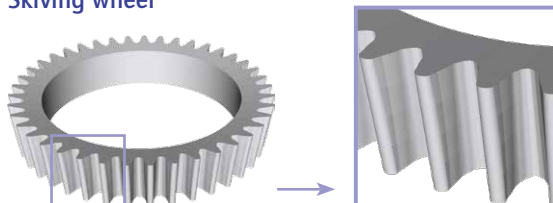
Given its economic efficiency and flexibility, skiving is primarily suitable for cutting internal gearings and gearings with process-limiting interfering contours (examples see Fig. 1). The range of parts includes involute cylindrical gears with any correction, splines and serrations as well as cogged belt and sprocket profiles. Fig. 2 shows examples of workpieces that demonstrate the tool design capability of PTM.

2 Profile-dependent challenges in skiving

Involute gear with protuberance



Skiving wheel



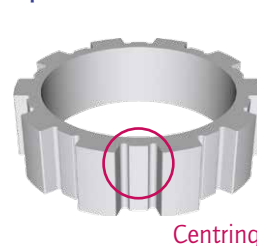
Manufacturing of skiving wheels

Once a skiving wheel has been designed, its profile and its geometry parameters are the system-compatible input parameters for production preparation in PTM. Cylindrical skiving wheels can readily be made by profile grinding. Depending on rake face form, helix angle and diameter, the grinding wheel profiles result from grinding simulation in PTM. The method of choice for relief grinding of tapered skiving wheels is discontinuous generation grinding (Fig. 3). The calculation of profiled grinding wheels and presetting of the permissible generating cut deviation in PTM guarantee the machining of tools to prescribed tolerances with the minimum number of reciprocating strokes. The wheel profile and the kinematics subroutine can be directly taken over by the grinding machine via standard interfaces. For making skiving tools with inserts, the cutting edge geometry in the chip plane is available as a standard output for insert grinding.

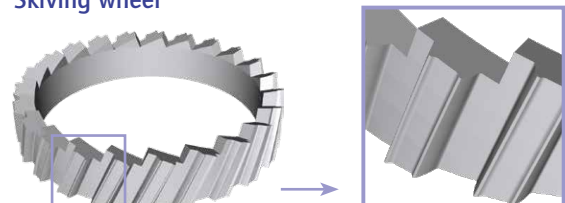
Quality check

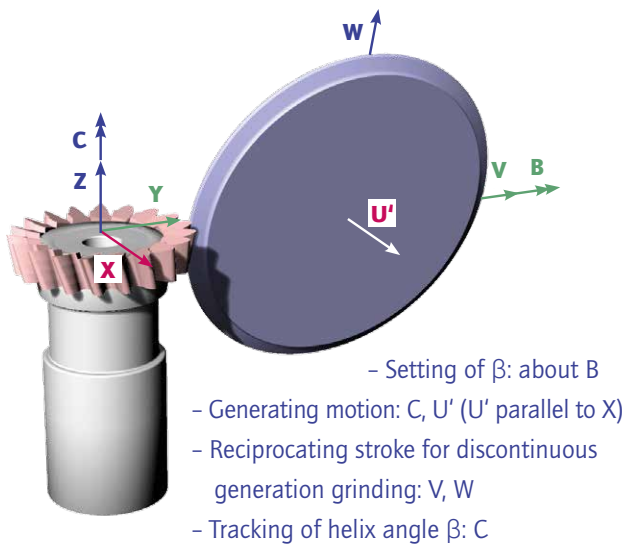
Optional linking of HAWK, ESCO's measurement and data analysis software, is the logical step to complete the software tools for the process chain. The profile of the skiving wheel and all its relevant features can be inspected completely utilizing the same database that is used for designing and manufacturing (Fig. 4). To check the result of the manufacturing process, the nominal geometry is derived from the 3D simulation of the grinding process (Fig. 5). For assessing quality with regard to the skiving wheel used in gear cutting – also in the reground state –, PTM designs the ideal tool geometry as a reference standard.

Spline shaft with centring



Skiving wheel



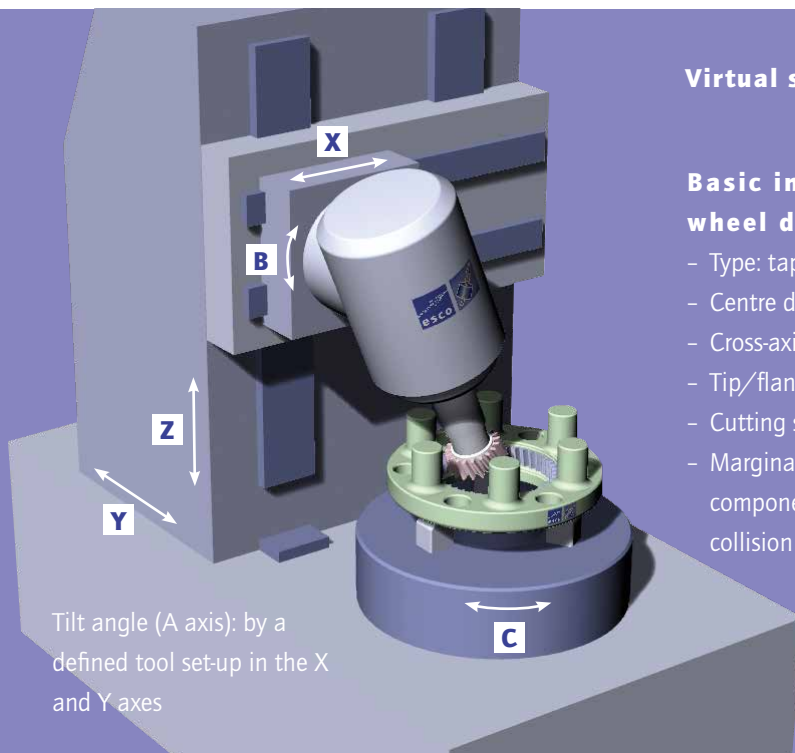


- Setting of β : about B
- Generating motion: C, U' (U' parallel to X)
- Reciprocating stroke for discontinuous generation grinding: V, W
- Tracking of helix angle β : C

3 PTM model of discontinuous generation grinding of tapered skiving wheels, simulation in EVA4D



4 Measuring a skiving wheel on a Werth VideoCheck VHA; measurement and evaluation software: HAWK



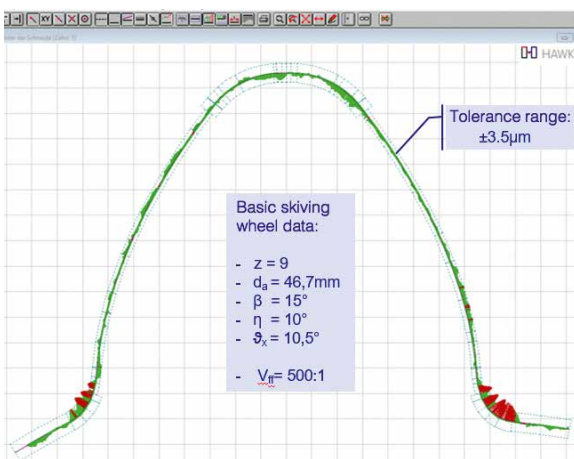
Tilt angle (A axis): by a defined tool set-up in the X and Y axes

Virtual skiving machine

Basic influencing parameters in skiving wheel design

- Type: tapered/cylindrical, solid/with inserts
- Centre distance/tooth ratio
- Cross-axis angle and/or tilt angle
- Tip/flank clearance angle
- Cutting speed
- Marginal workpiece conditions, e.g. interfering components in the areas of the required overtravel, collision conditions

5 Non-topping skiving wheel with stepped face, discontinuous generation-ground profile: tactile profile measurement at the cutting edge



PTM with EVA4D and HAWK: Achieving high-precision skiving wheels matching almost any type of gearing

PTM, EVA4D and HAWK

- are modularly configurable system components,
- can be used independently or integrated into the company's IT environment via standard or user-specific interfaces,
- ensure exact design, simulation and evaluation results,
- are future-oriented solutions, which will be continuously upgraded as the method of skiving will develop further regarding new capabilities and user requirements.



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