

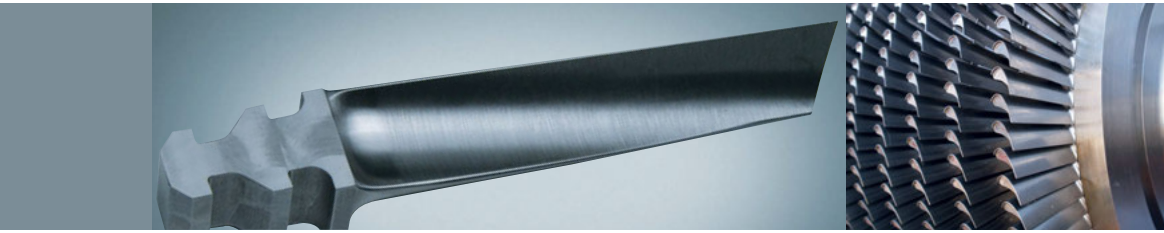
A 3D CAD rendering of a 5-axis milling process. A red and yellow mill head is positioned above a grey turbine blade. Yellow lines represent the tool's path as it mills the blade's surface. The background is a blue gradient with a grid pattern.

*hyper*MILL[®]

5Axis Machining

Turbine blade
milling – Complete
from top to bottom

TURBINE BLADE



The *hyperMILL*® turbine blade package – everything you need

The complete machining of turbine blades is made possible by milling strategies optimised for turbine blade machining, supplemented by cycles for the machining of mechanical attachment features and the milling of special blade geometries. Automated functions provide a simple machining definition and extremely short programming times. In addition, high feedrates and the use of larger tools reduce production times.

Straightforward:

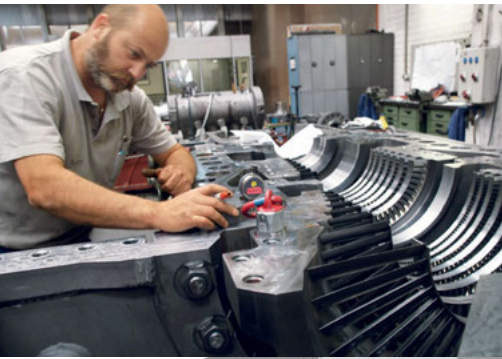
hyperMILL®'s clear and concise job list makes it possible to incorporate machining steps from comparable projects into a new job list. In this way, the efforts required for programming are considerably reduced. Using the graphical user interface, 5axis machining is as simple to program as 3D operations.

Accurate: Additional functions improve machining accuracy and surface finishes. For example, guide surfaces can be used for a more uniform movement of the milling tool, without the need to change the geometries to be milled.

Flexible: Integration in *hyperMILL*® means that 2D, 3D and 5axis cycles with broad applications are available alongside specialised machining strategies. Users thus enjoy a high degree of flexibility when choosing the optimal machining strategy and tools. And there is no need for a second CAM system.

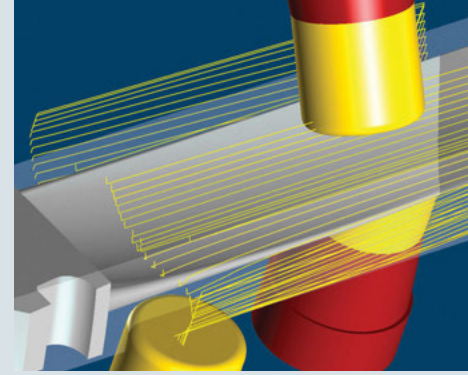
CAD-based

hyperCAD® makes it easy to construct high-quality turbine blade models from point and curve data. Elements that are important for the quality and reliability of the machining job can be easily integrated into these models. Elements include, amongst other things, guide surfaces or parts for collision testing.

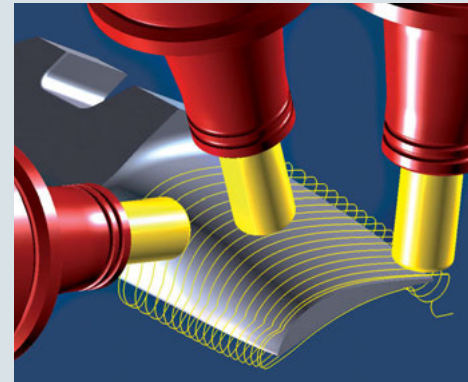


Optimized: Special functions are provided to automate programming. These include the Rolling Ball function for the milling of transition radii, the Best Fit function for automatic setting of the optimal start position for the finishing process, and the automatic lead angle correction function for collision avoidance.

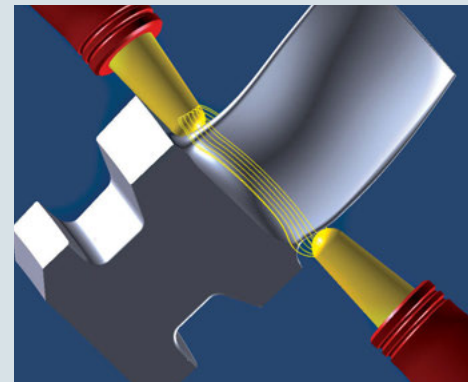
3D arbitrary stock roughing: On the basis of a freely-definable stock, the turbine blades are machined from various directions. The strategy automatically prevents redundant movements during undercuts. Constant cutting depths and a feedrate independent of the rotary axes guarantee constant cutting conditions. Clamping of the rotary axes enables the use of larger tools and leads to a high stock removal rate.



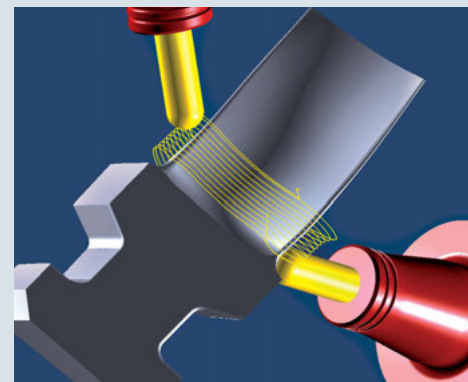
5axis blade top milling: In this cycle, top milling is used for the finishing of blade surfaces. It is possible to generate spiral tool paths either as 5axis or 4axis simultaneous machinings. With endmills and bullnose endmills, the lead angle is always automatically corrected to prevent surfaces from being damaged and to make sure the tools are always cutting on the front edge.



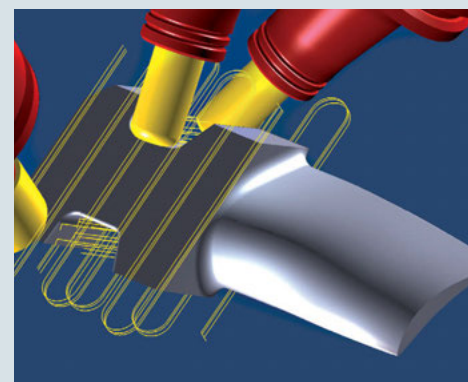
5axis blade swarf cutting: With 5axis flank machining, it is possible to machine the transition between the blade and side surfaces that cannot be milled using 5axis top milling. Lead and side slope angles ensure optimal cutting conditions. In addition, 5axis flank machining makes it possible to create slightly curved side surfaces quickly using swarf cutting.



5axis blade fillet milling: This function optimizes the finishing along the intersection between a blade and the side surfaces from the shroud and the hub. The cross-fade paths to the blade machining ensure very high quality surfaces. As an option, a "rolling ball" radius can be generated automatically. The tool simultaneously maintains contact with the blade and the optimally smoothed boundary to the side surface. In this way, a perfect transition is achieved, also with regard to the neighboring blades. In many other CAD systems this type of machining cannot be configured.



Additional strategies for the machining of mechanical attachment features: A series of 2D and 3D strategies are available for machining the base of the blade. The 2D strategies include drilling, face milling, curve and pocket milling. Roughing cycles, finishing operations for base geometry and strategies for trimming, deburring or the sharpening of curved surfaces are included in the 3D operations.



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