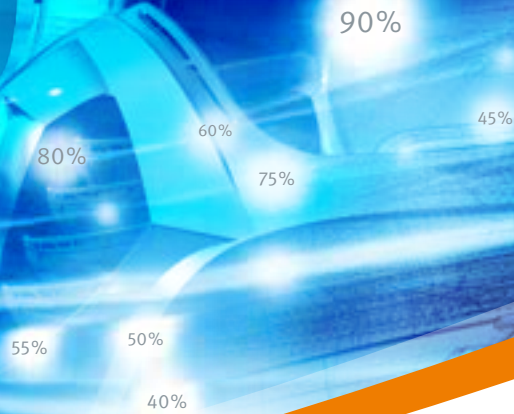


hyperMILL®

MAXX Machining



Performance Strategies Drilling, Roughing, and Finishing

PERFORMANCE

Performance, Performance, Performance

Consistent high speed across all application areas

Nowadays, speed is more important than ever before. This is why OPEN MIND has developed a high-performance solution for drilling, roughing, and finishing on milling and mill-turn machines, namely its *hyperMILL*® MAXX Machining performance package. Milling tools tilted in the cutting direction can drill holes in materials that are difficult to machine both quickly and easily, and without any predrilling. Optimized pocket strategies and trochoidal toolpaths ensure extremely fast material removal. Innovative strategies for barrel cutters and rollFEED® turning inserts allow finishing to take place in record time.

Time savings with no loss of quality

These unique solutions from OPEN MIND allow significant time savings while ensuring the same high quality. This means that CAM programmers can always maximize machine performance.

Possible applications

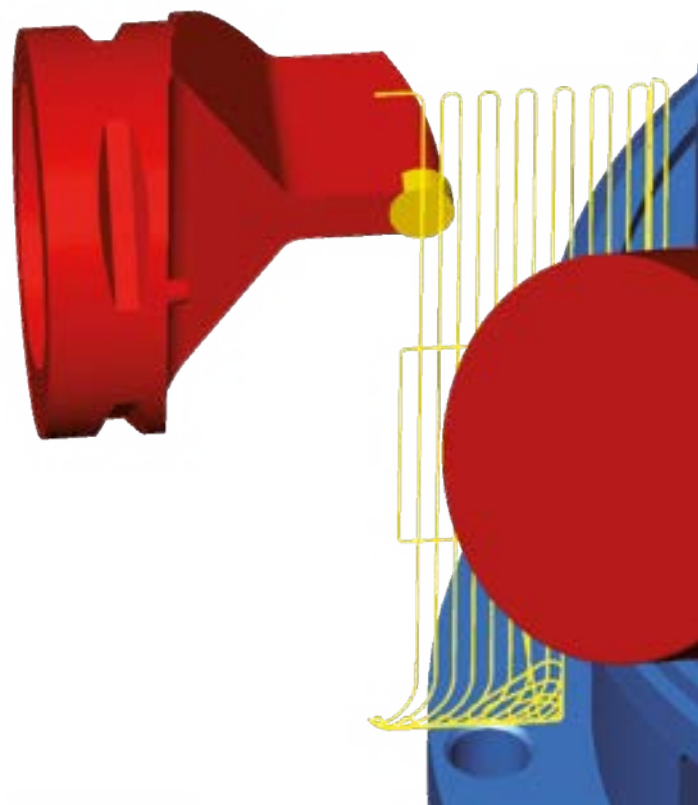
- Tool and mold making
- Production machining
- Aerospace
- Automotive
- Motor sports
- Energy industries



Drilling

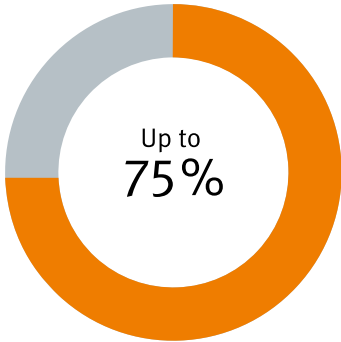
Roughing

Finishing

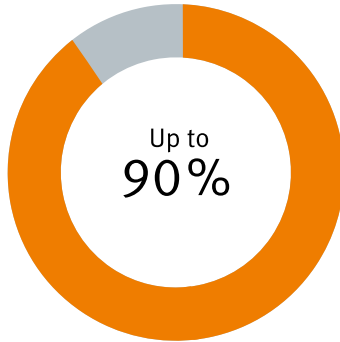


hyperMILL[®]

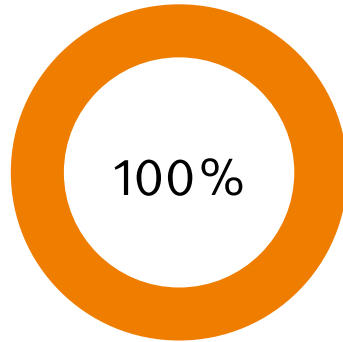
MAXX Machining



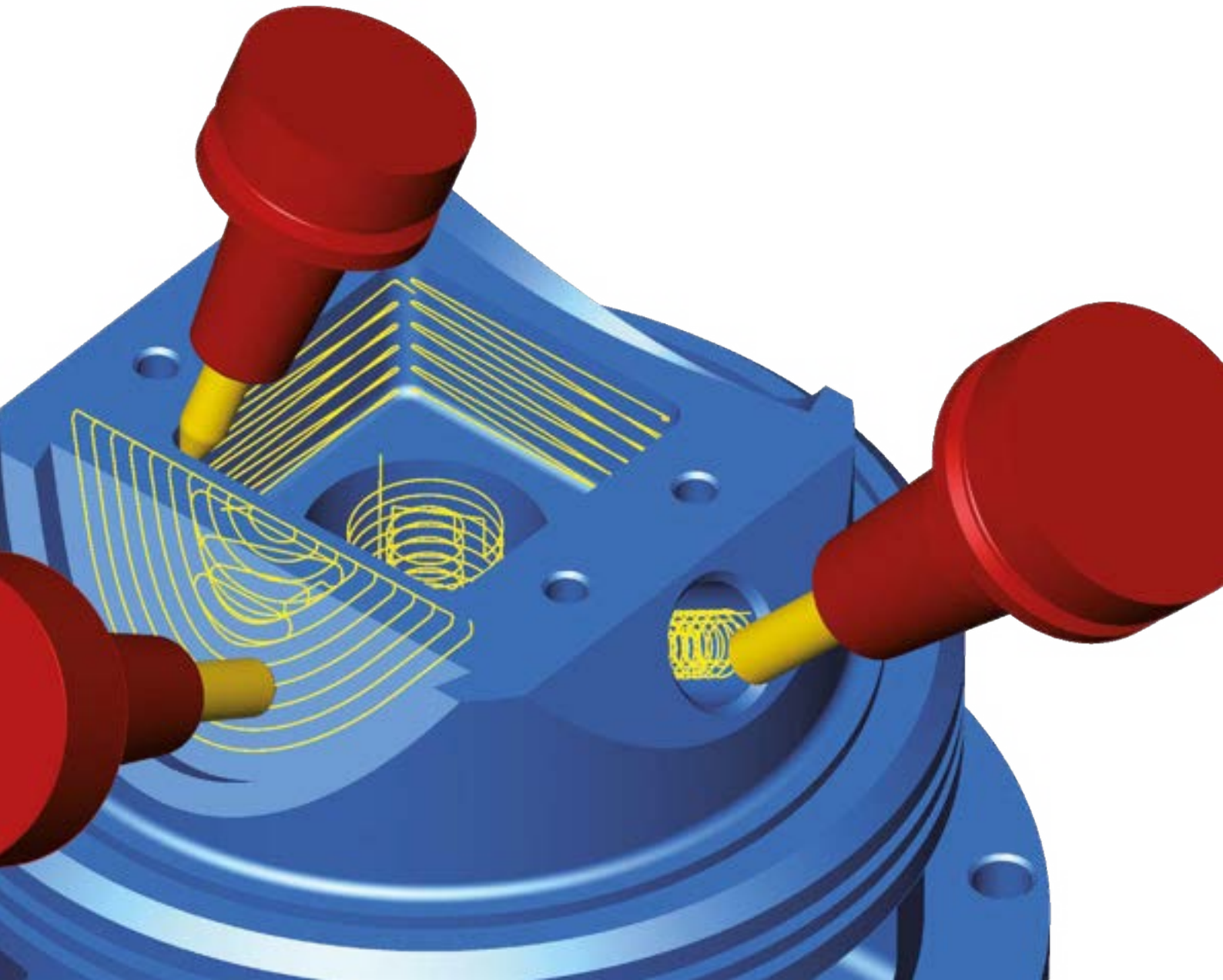
Time savings
for roughing



Time savings
for finishing

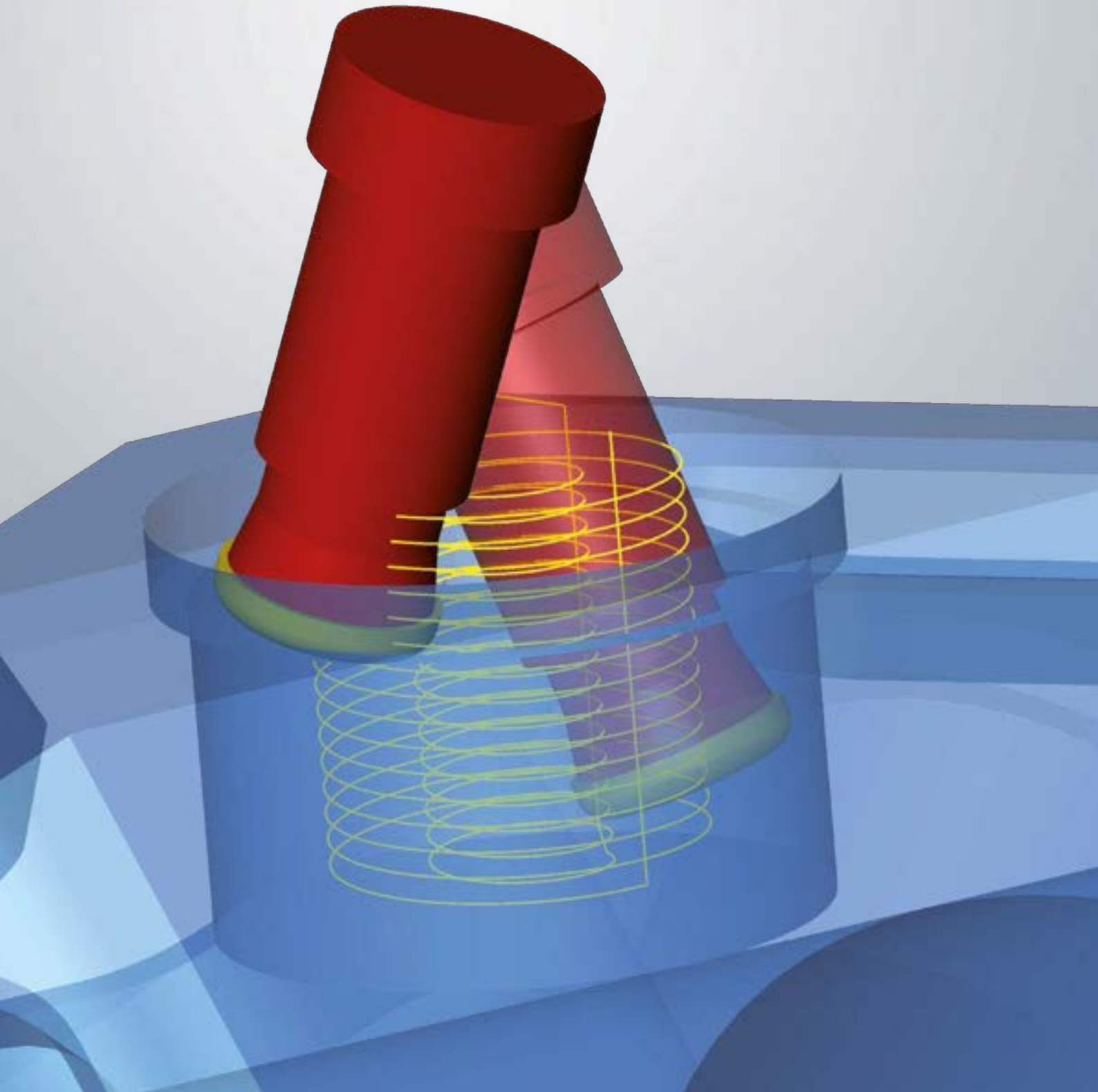


Process safety



“There’s no better method for removing high chip volumes in such a short amount of time. Yet another example of the superiority of 5axis simultaneous machining for such a seemingly simple task.”

Dr. Josef Koch, CTO of OPEN MIND Technologies AG



MAXXimum drilling

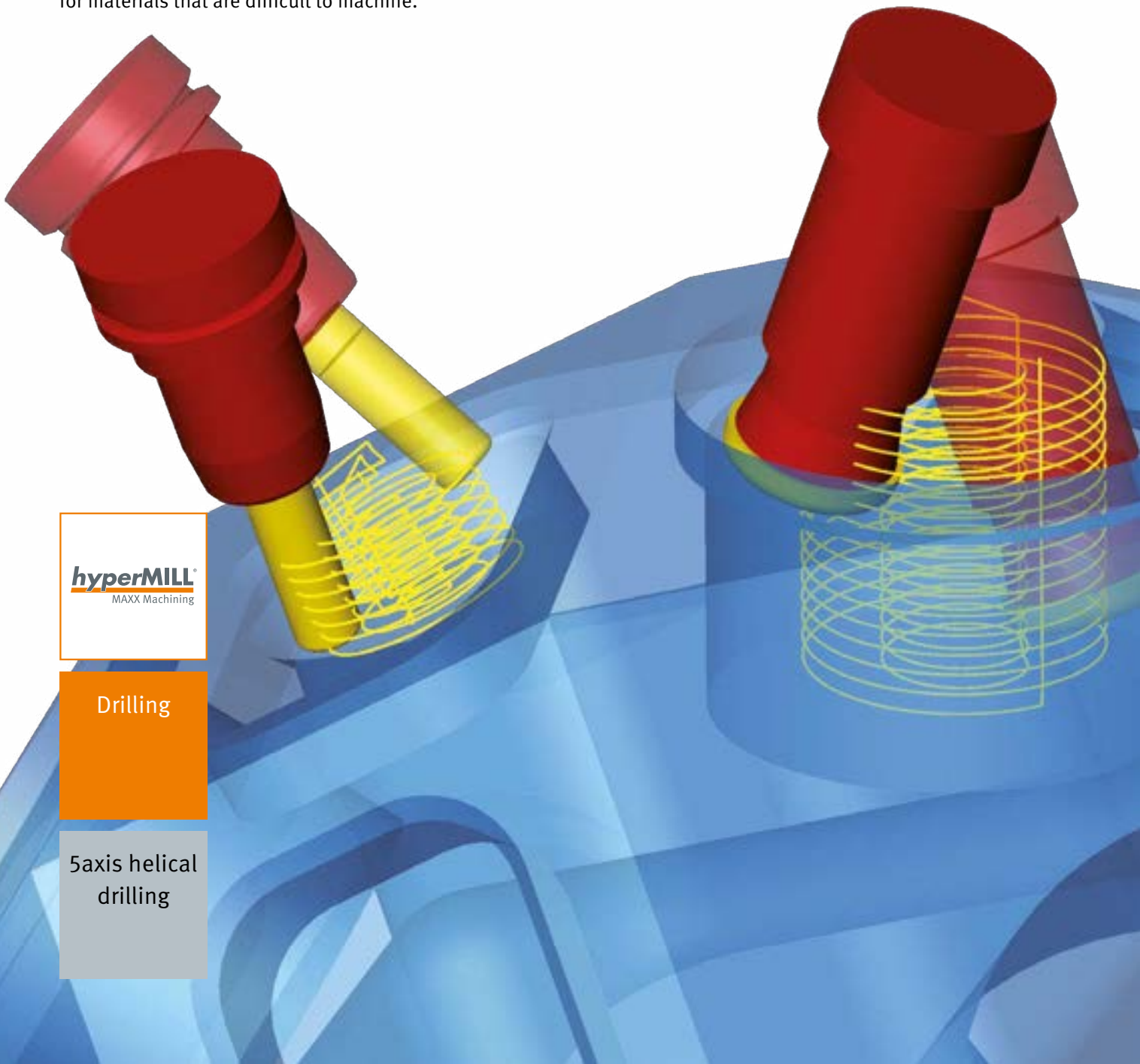
5axis helical drilling is a helical tilt milling method. Here, the milling tool is tilted forward in the cutting direction. A second tilt helps to avoid collisions with the hole wall. This strategy is excellent for making an opening cut when roughing deep cavities. Material can be removed from circular pockets in a highly efficient and tool-friendly manner.

5axis helical drilling
Highly efficient roughing
of a circular pocket
with an indexable end mill.

Drilling has never been faster

Efficiency through 5axis technology

The helical drilling cycle generates helical toolpaths. This 5axis simultaneous machining strategy greatly improves the cutting conditions, compared to conventional helical drilling. It is this technology, in particular, that has actually made it possible to use milling tools that are not center cutting. The major advantage is that the tool plunges into the material quickly, without the need for any predrilling. Intelligent 5axis orientations of the milling tool ensure efficient and particularly tool-friendly machining, as well as the safe removal of chips without recutting of these. This cycle is ideal for materials that are difficult to machine.



hyperMILL
MAXX Machining

Drilling

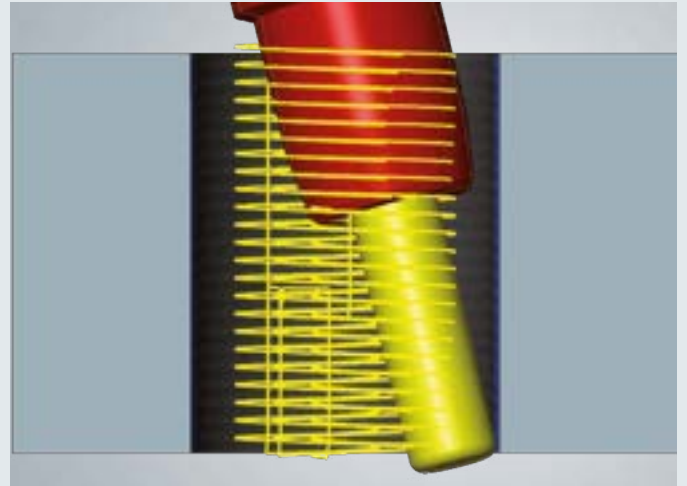
5axis helical
drilling

Advantages

- Fast and efficient plunging
- Especially suitable for materials that are difficult to machine
- Excellent for opening deep cavities with large milling heads
- No predrilling necessary
- Gentle on tools
- Safe chip removal
- Also suitable for milling tools that are not center cutting

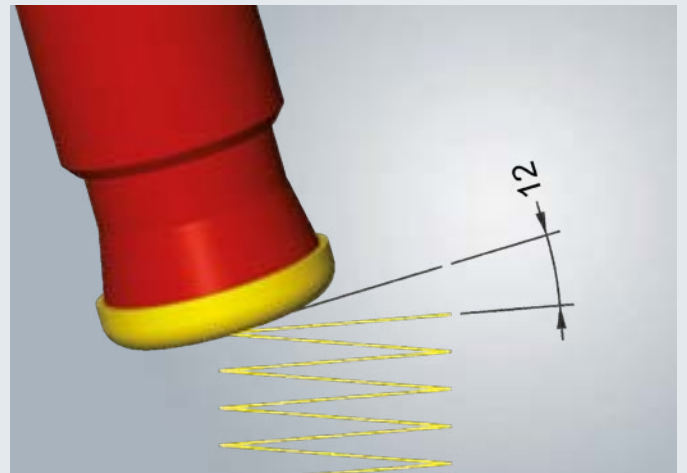
■ Process reliability

Maximum safety thanks to fully automatic collision avoidance.



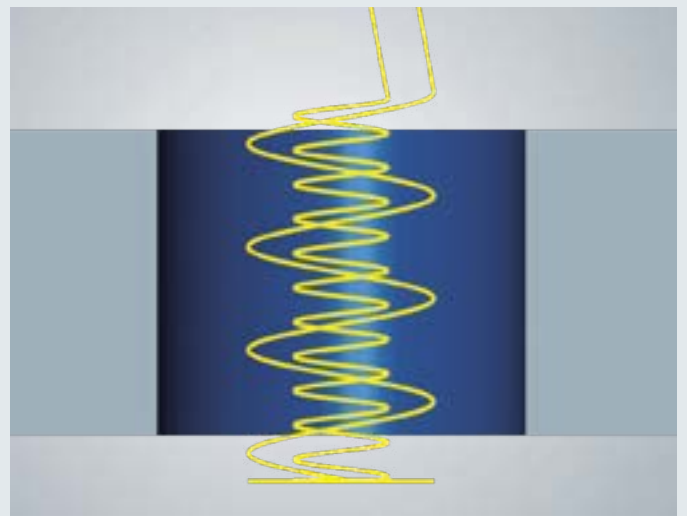
■ Lead angle

In contrast to traditional 3D machining, a lead angle allows machining to also take place with milling tools that are not center cutting.



■ Automatic pitch adjustment

In the event of a potential collision, this function automatically adapts the pitch until collision-free machining is possible.



Our HPC technology, which has proven successful in milling, now ensures greater performance and process reliability in turning!”

Dr. Josef Koch, CTO of OPEN MIND Technologies AG



MAXXimum roughing

The roughing module in *hyperMILL*® MAXX Machining offers solutions for high-feed cutting (HFC) and high-performance cutting (HPC) with spiral and trochoidal tool movements. The package combines optimal toolpaths, maximum material removal, and high feedrates, and therefore enables the shortest possible machining times.

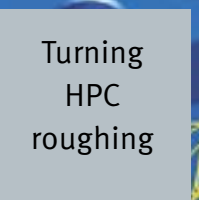
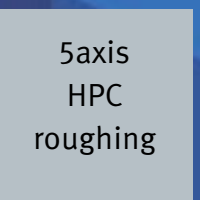
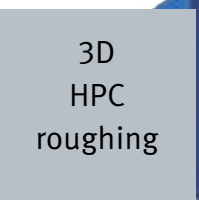
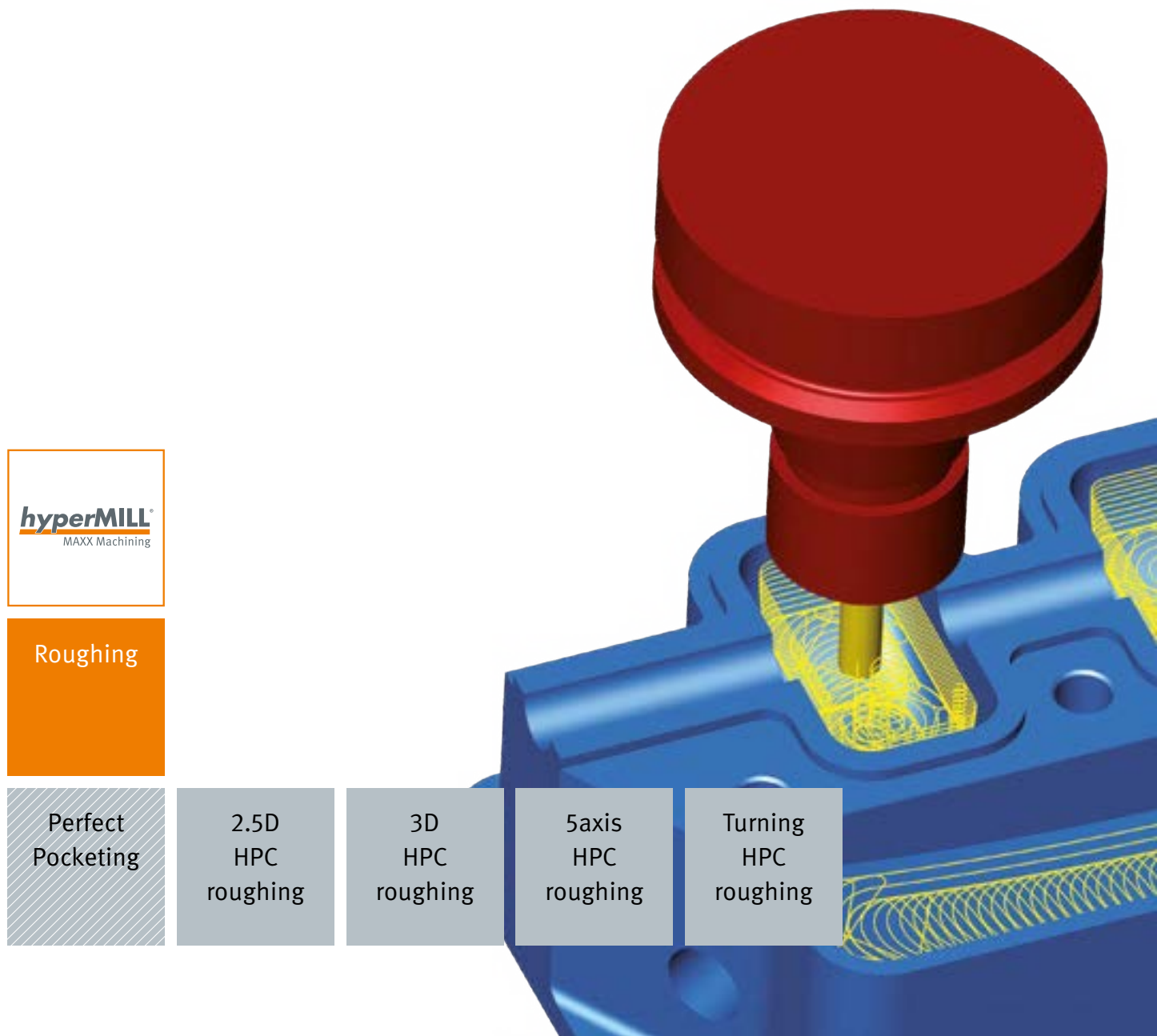
HPC roughing
Trochoidal toolpaths
for turning and milling
operations

Maximum Roughing Performance

Innovative strategies for milling and turning tasks

The roughing module is a comprehensive and powerful package for generating HFC and HPC toolpaths. The Perfect Pocketing technology from OPEN MIND fits pockets perfectly into the area to be machined and optimizes the toolpaths for high feed machining.

Trochoidal toolpaths can be generated for milling and turning operations. Both technologies significantly increase the material removal rate and enable considerably reduced machining times. Two options are therefore available to the user for fully exploiting the potential of the machine and tool.



Advantages

- Reduced machining times
- Extended tool life
- Machining that is easier on the tool and the machine
- Optimal use of machine and tool potential
- Simple to program

Optimization options

■ Maximum reduction in machining times

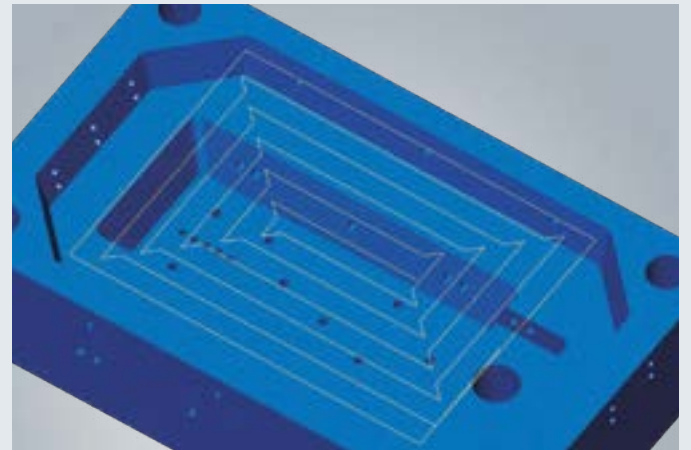
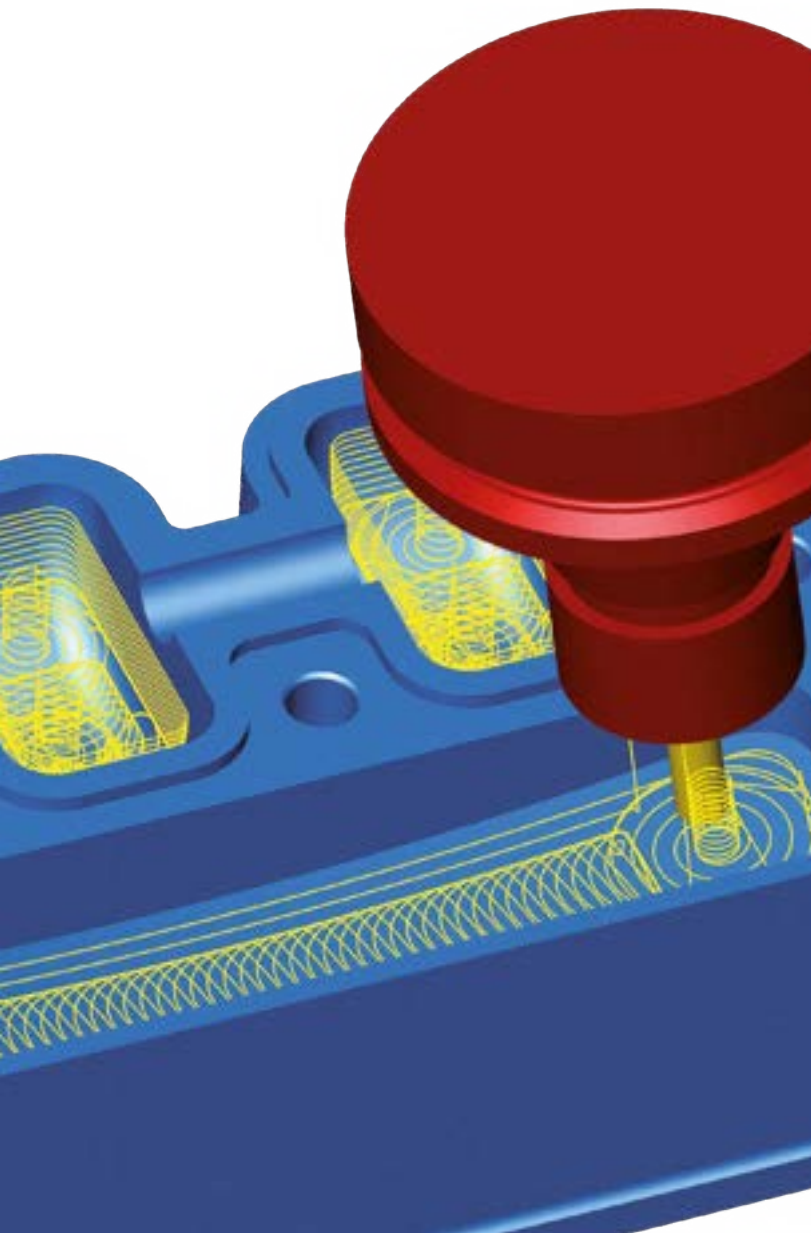
hyperMILL® MAXX Machining reduces machining times significantly when compared to conventional roughing. The use of high-feed cutters and high-performance machining with spiral and trochoidal toolpaths ensure greater material removal.

■ Maximized tool life

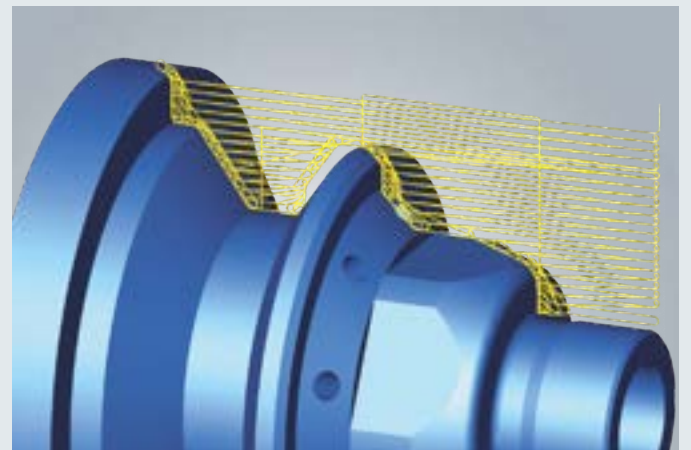
hyperMILL® MAXX Machining allows high-feed and high-performance cutters, as well as turning inserts, to be optimally used. The innovative design of the toolpaths reduces the load on the tool. This, in turn, increases the tool life, particularly when processing harder materials.

■ Maximum programming freedom

hyperMILL® MAXX Machining ensures that the toolpaths are generated automatically and with collision checking. Users have the option to customize machining parameters such as feedrates and infeeds.



Pocket machining, optimized for high feed machining



High-performance turning with trochoidal toolpaths

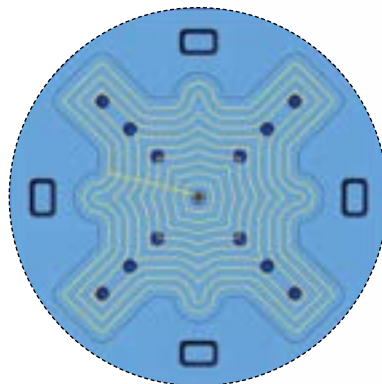
Pocket strategies for maximum speed

Efficient pocket machining

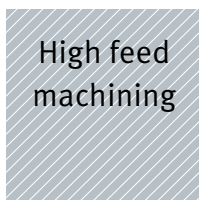
As varying requirements are made on the tool and material, different technologies must be used to ensure efficient roughing. Perfect Pocketing technology stands for efficient roughing with adapted pockets. The linear toolpaths ensure maximum feedrate values for both standard and high-feed cutters. Depending on the specific machining application, it may be more efficient to use Perfect Pocketing technology than high-performance roughing.

Linear toolpaths for high feedrates

An intelligent algorithm ensures that the largest possible pocket is fit into the area to be roughed. Linear and contour-parallel toolpaths are optimally linked. This results in maximum feedrate values.

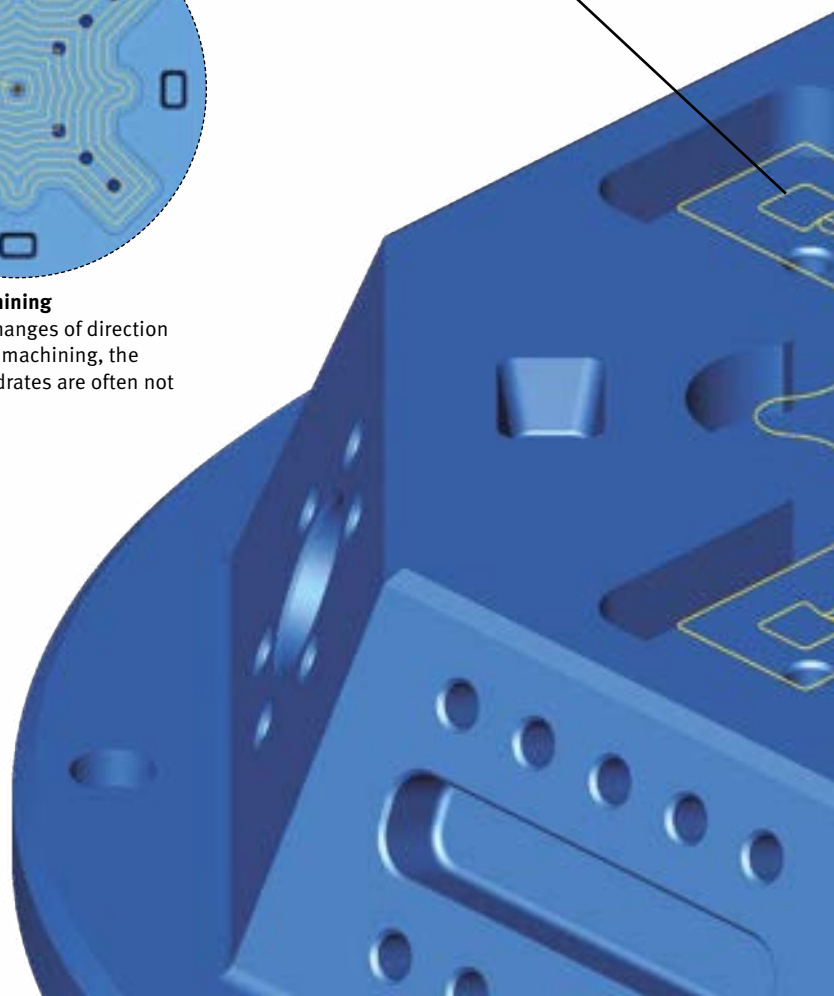


Rest material areas are integrated into the machining via contour-parallel toolpaths



Conventional machining

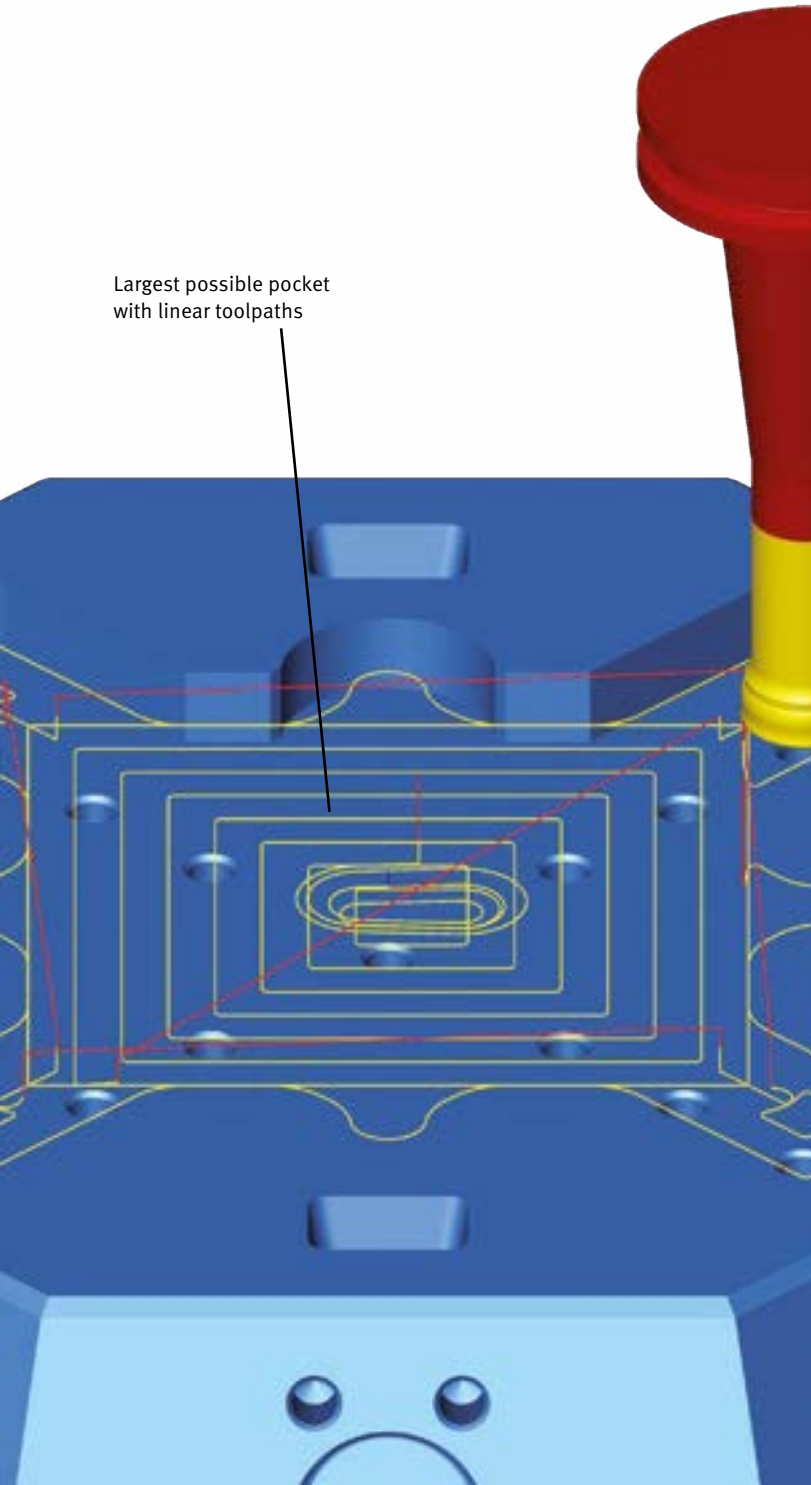
Due to the many changes of direction in contour-parallel machining, the maximum axis feedrates are often not attained.



Advantages

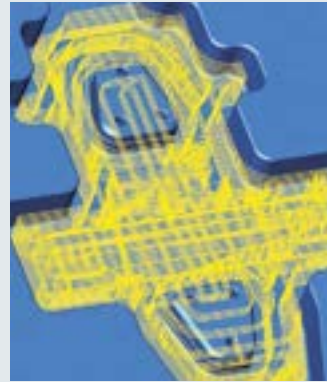
- Reduced machining times
- Generation of linear toolpaths
- Tool potentials are fully exploited
- Specially optimized toolpaths for high-feed cutters
- Simple to program

Largest possible pocket
with linear toolpaths

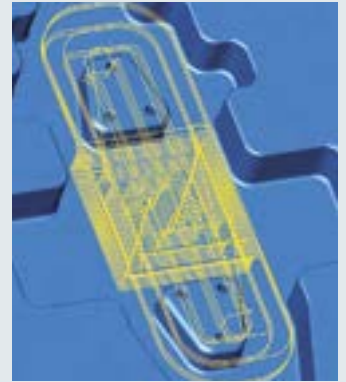


■ Adaptive pocket

This function fits pockets optimally into the area to be roughed. This means that as much of the area as possible is machined with linear machine movements. Machining can be carried out either as a pocket or as a pocket in conjunction with contour-parallel toolpaths. Particularly when handling large pockets, machining with high-feed cutters and subsequent rest machining is faster than using contour-parallel roughing of the entire pocket.



Pocket machining with contour-parallel roughing paths



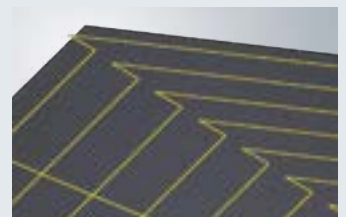
Fitted pockets with linear toolpaths

■ High feed machining

hyperMILL® offers the 'High feed machining' option for pocket machining to make the best possible use of high-feed cutters and their special cutting geometry. The lateral infeed can be automatically calculated by defining a scallop height. Special movements have been implemented to avoid rest material in corners. This ensures safe and complete machining without any rest material.



HFC machining without corner movements: rest material in corners



HFC machining with corner movements: no rest material

■ Features

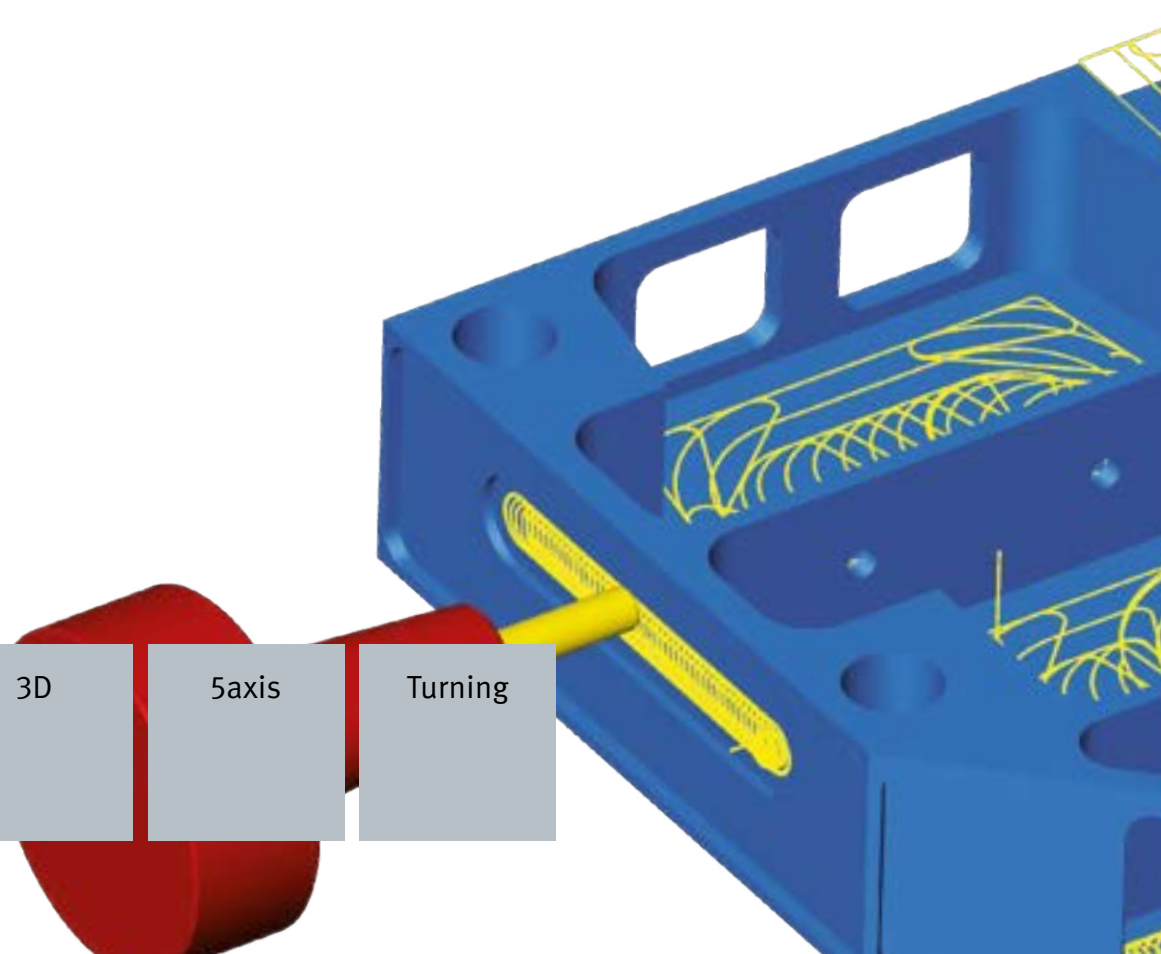
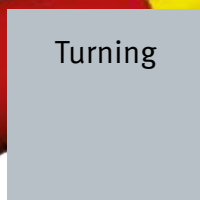
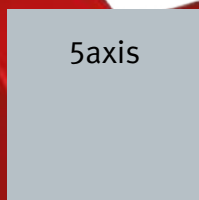
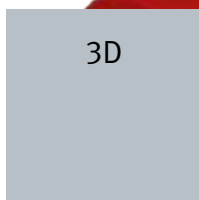
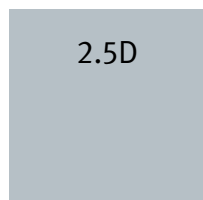
- Automatic creation of linear toolpaths for maximum feedrates
- Machining especially optimized for high-feed cutters
- The cutting geometry of the milling tool is fully modeled in the CAM system

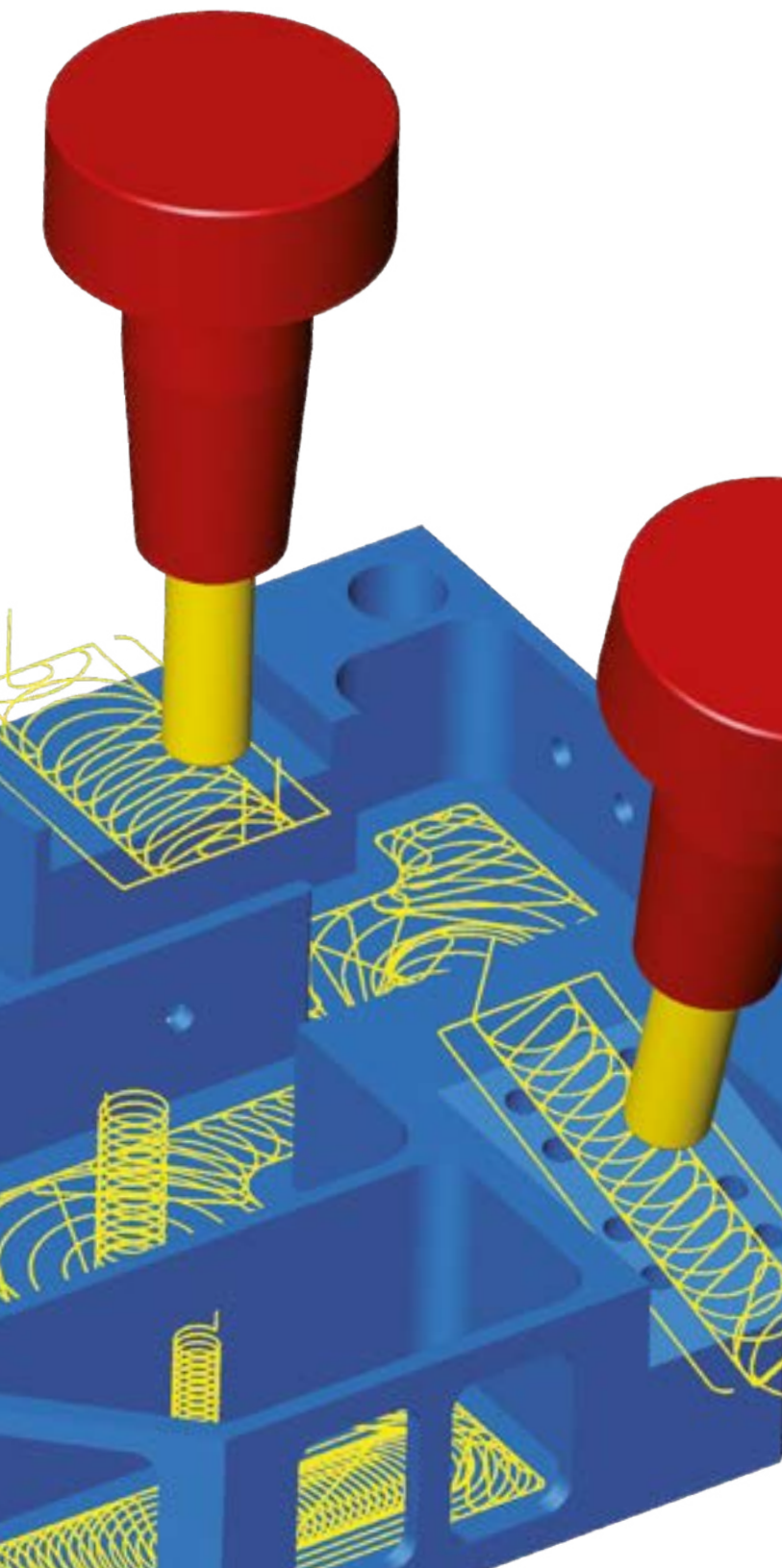
HPC toolpaths for maximum roughing results

Efficient milling and turning

A significantly higher material removal rate is achieved in high-performance cutting than with conventional roughing. High cutting speeds and feedrates ensure extremely fast machining. At the same time, there is much less stress on the tools and machines. 2.5D, 3D, and 5axis milling operations, as well as turn roughing jobs can therefore be carried out easily and quickly.

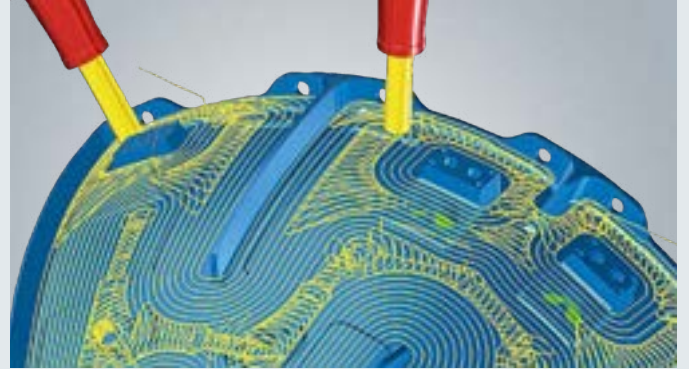
This module is based on the proven, best-in-class HPC technologies from Celeritive™ and the highly efficient special developments from OPEN MIND.





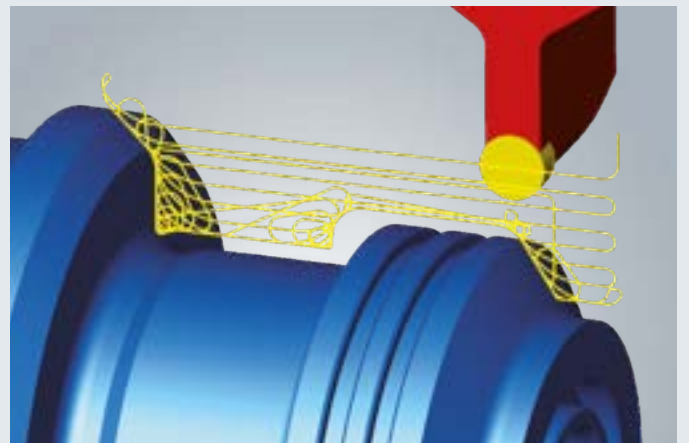
■ Milling

hyperMILL® MAXX Machining guarantees efficient and safe machining on 3axis and 5axis machines. 5axis simultaneous machining allows trochoidal toolpaths to also be generated on curved component surfaces.



■ Turning

Trochoidal toolpaths can also be generated in turning. Round inserts can be used much more efficiently, and the cutting performance is further increased.



■ Features

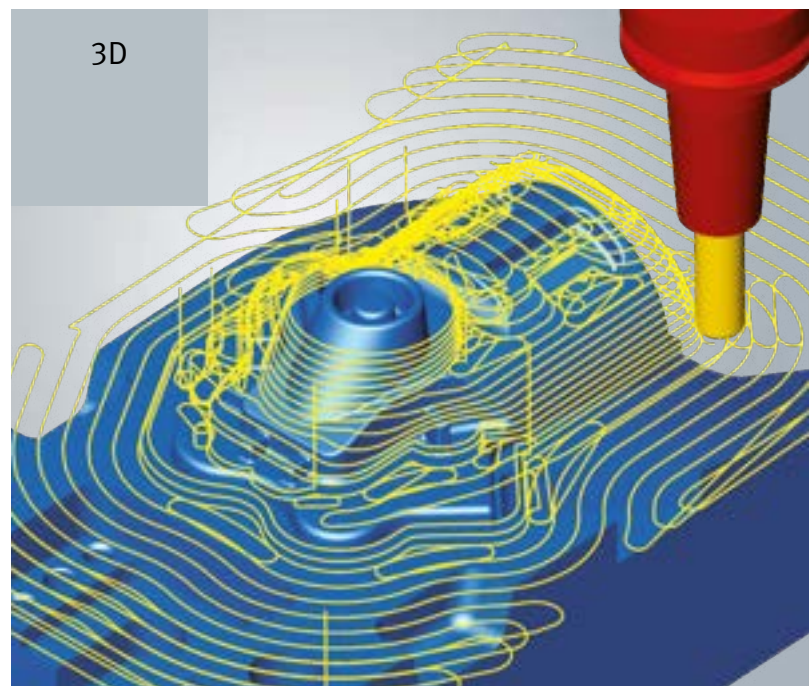
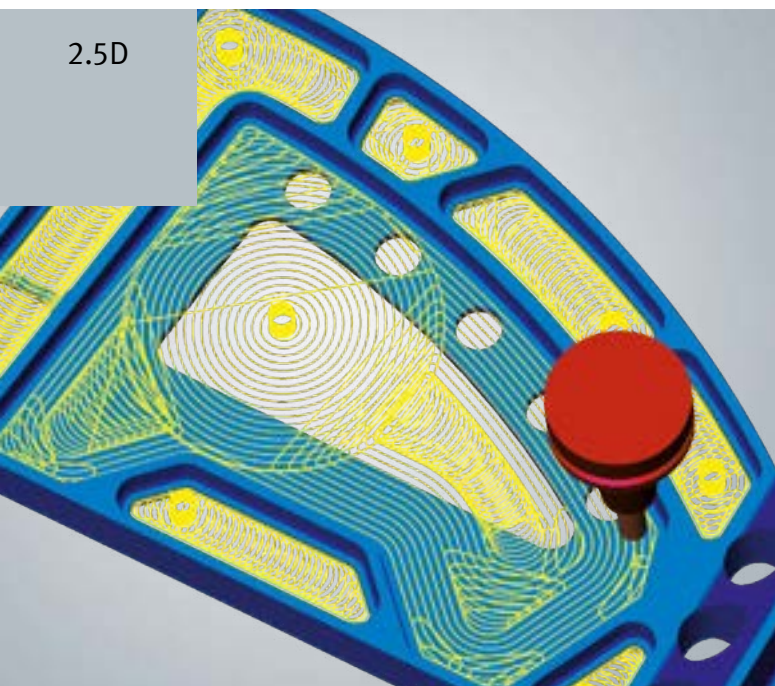
- Creation of spiral and trochoidal toolpaths for 2.5D, 3D, and 5axis simultaneous machining and turning
- Intelligent feedrate adjustment
- Fast repositioning in high-speed mode with the tool being raised slightly off the bottom
- Full cuts and abrupt changes of direction are prevented
- Intelligent division of cuts during 3D machining
- High material removal rates, even with materials that are difficult to machine
- Uses proven HPC technology from **celeritive**™

High performance for milling

5axis simultaneous roughing of curved surfaces

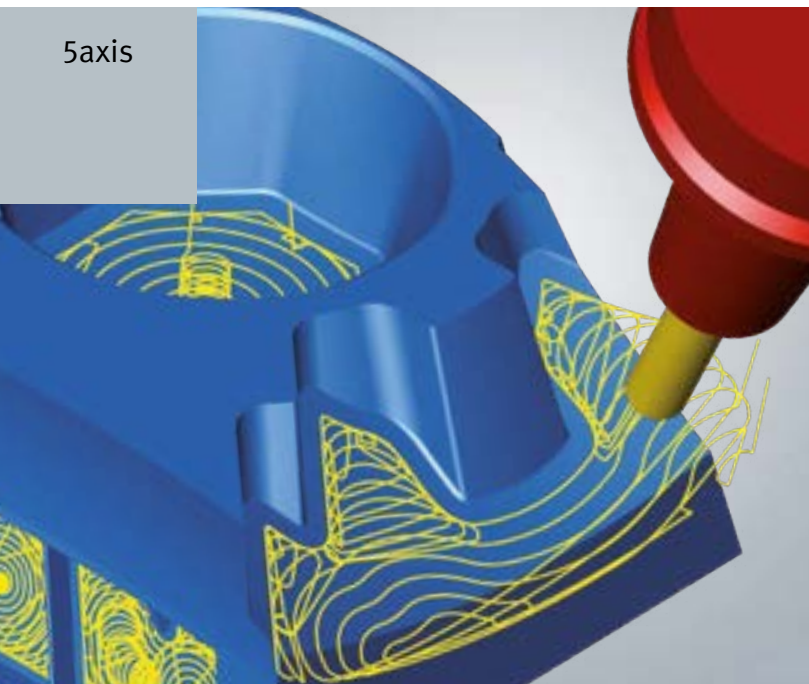
Users have maximum freedom when programming 2.5D, 3D, or 5axis machining operations. Optimal cutting conditions, combined with large Z stepdowns, ensure extremely efficient 2.5D machining for grooves, pockets, and prismatic workpieces. During 3D machining, *hyperMILL*® MAXX Machining divides the component geometry optimally into different planes. The intelligent design and sequence ensure time and path-optimized machining of these planes.

Given its pioneering role in 5axis machining, it is a matter of course for OPEN MIND to offer something special, namely its comprehensive 5axis HPC package. This allows spiral and trochoidal-like paths to be mapped to curved component surfaces in a unique fashion.



“When it comes to materials that are difficult to machine, we achieve high-volume material removal in HPC machining thanks to a large stepdown depth with small lateral stepover and maximum feedrates. *hyperMILL*® MAXX Machining ensures that the tool load also remains constant in corners and that the life of the milling tools is fully exploited.”

Dr. Christian Wilkening,
CEO at 5AXperformance GmbH



■ **Intelligent feedrate adjustment**

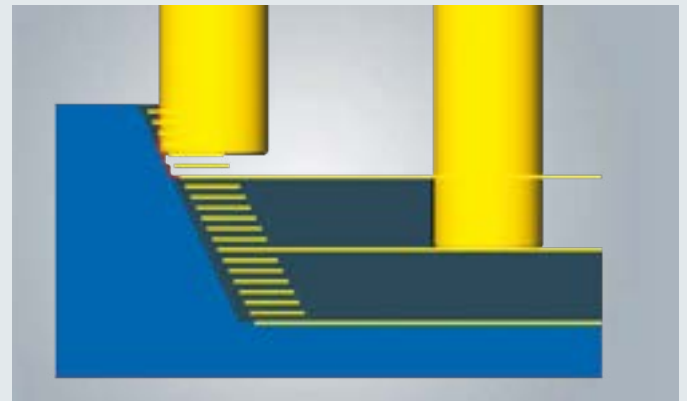
Special automated functions analyze the local component conditions – wrapping and speed at the edges – and automatically adjust the feedrates along the toolpath.

■ **Maximum stock removal rate**

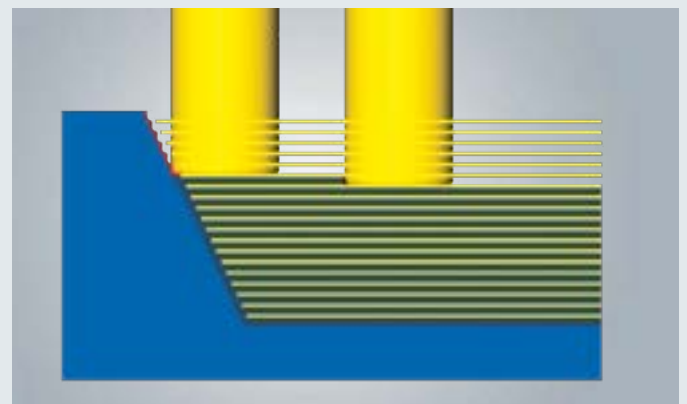
hyperMILL® MAXX Machining allows users to define minimum and maximum feedrate values for different machining situations, such as for the approach, the plunge, and for the actual machining on the plane. This way, the average working feedrate is increased. At the same time, this strategy helps to prevent feedrates that are too low. It is possible to achieve a maximum stock removal rate thanks to machining using climb milling and the dynamic adjustment of the feedrate to the existing cutting conditions.

■ **Intelligent division of cuts**

hyperMILL® MAXX Machining automatically recognizes a machining situation with different planes and adjusts to the situation optimally. Material is removed with maximum stepdown depth; the remaining material is then removed from the bottom up in defined intermediate steps.



HPC machining with large stepdowns and intermediate steps



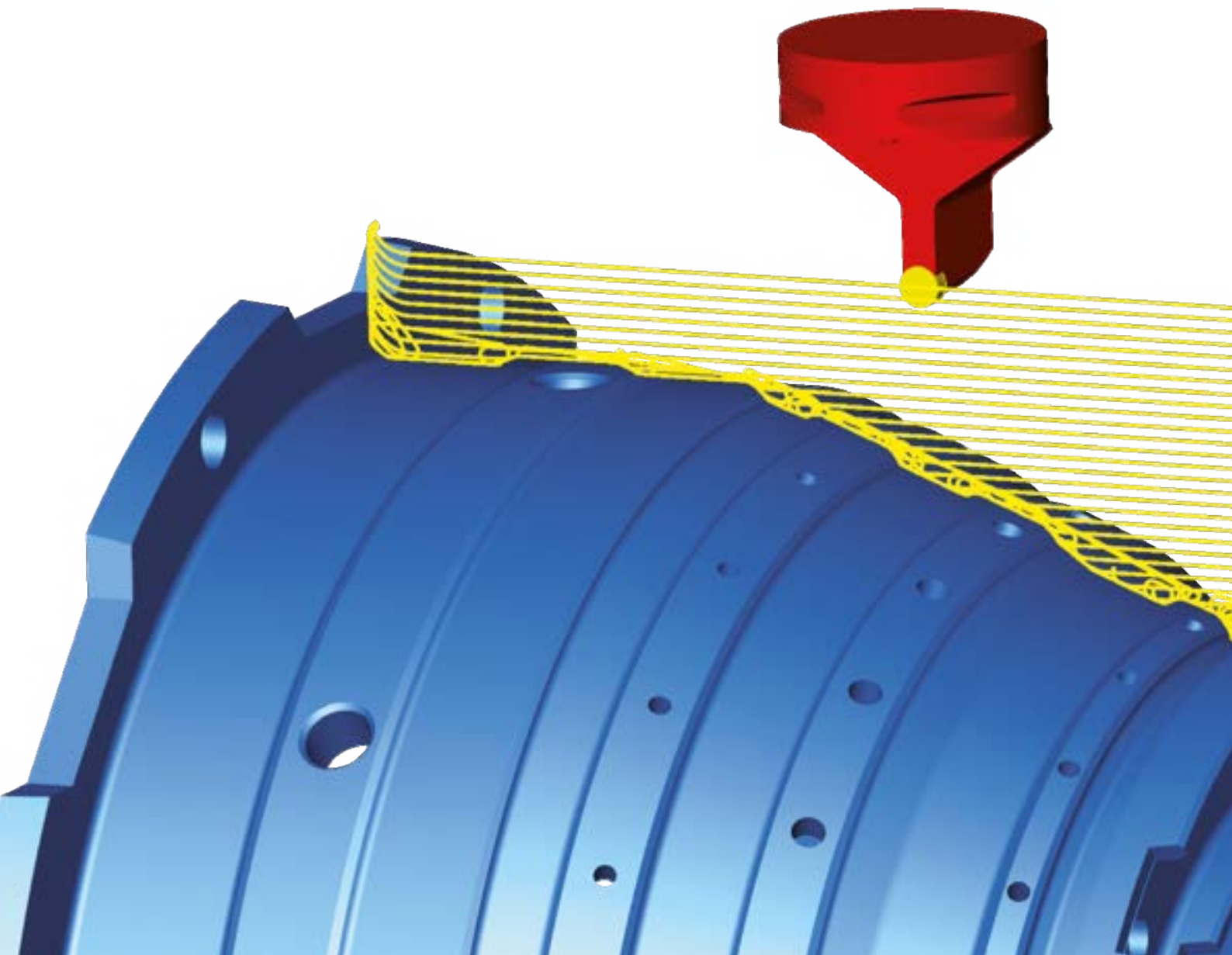
Conventional machining mode with minimal stepdowns

High performance for turning

Time savings plus extended tool life

The proven concept of trochoidal milling has been successfully applied to turning. *hyperMILL*® allows the technology to be quickly and easily applied to all turning parts. Round inserts can be optimally used thanks to the trochoidal toolpaths. The connecting paths between the individual toolpaths as well as their approach and retract movements are optimally adapted to the respective machining application. This reduces the machining time and also extends the tool life. In addition, smooth machine movements reduce the load on the individual axes of the machine tool.

This module, which is fully integrated in *hyperMILL*®, is based on VoluTurn™, a proven best-in-class HPC technology from Celeritive®.

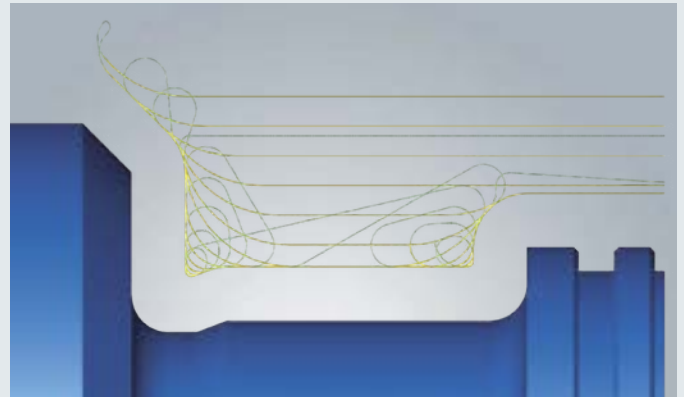


Advantages

- Increased process reliability
- Increased tool life
- High material removal
- Reduced number of tools needed
- Tool-friendly machining
- Simple to program

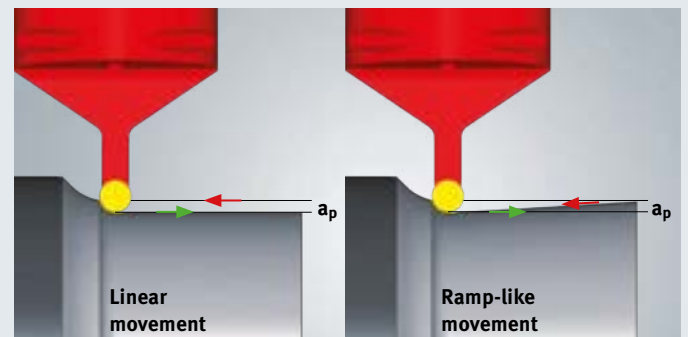
■ Trochoidal toolpaths

Intelligent algorithms calculate toolpaths that correspond to a trochoidal shape. The connecting paths between the individual paths as well as the approach and retract movements are perfectly harmonized. Optimized feedrates provide maximum speed.



■ Infeed strategies

Machining can take place with one-way or zig-zag movements. It is possible to select a linear or ramp-like movement for the infeed. Depending on the machining application, this means that the inserts can always be optimally used and fully exploited.

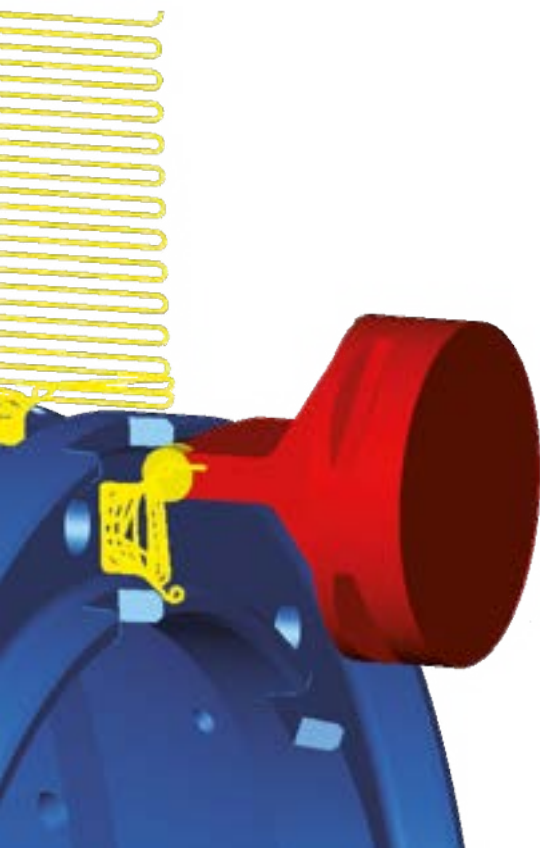


■ Simple programming

After the contours to be machined have been selected, *hyperMILL*® automatically generates the toolpaths for roughing. The time-consuming generation of individual cutting contours in the CAD system is not necessary. The tool and holder are fully collision checked.

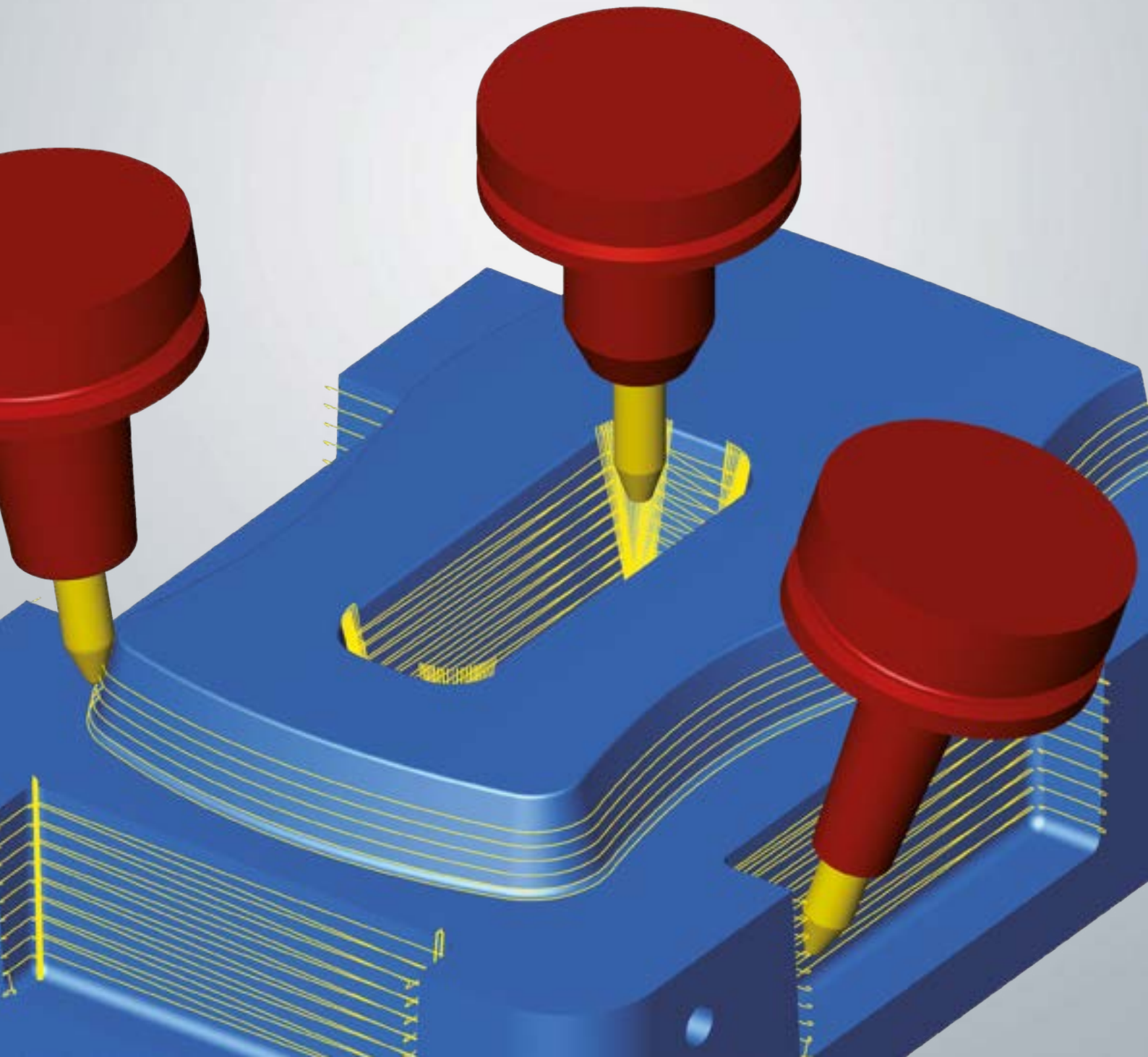
■ Tool life

Smooth approach and retract movements, and a changing contact point help to extend the tool life. Furthermore, the improved chip break behavior has a positive impact on process reliability. These effects are even more noticeable in materials that are particularly difficult to machine.



For more than 50 years, people thought they knew the best way to mill planar surfaces. OPEN MIND has now developed an innovative method for finishing planes in a highly efficient manner. This method offers exceptional savings potential, even for surfaces that are hard to reach.”

Dr. Josef Koch, CTO of OPEN MIND Technologies AG



MAXXimum finishing

The finishing module of *hyperMILL*® MAXX Machining is a solution for highly efficient semi-finishing and finishing with barrel cutters and rollFEED® turning inserts. The large tool radii allow greater step-overs, and an equivalent or much higher surface quality is achieved. Numerous strategies ensure a wide range of applications and guarantee optimal and safe machining.

Finishing various surfaces

Highly efficient machining of planes, free-form surfaces, and fillets

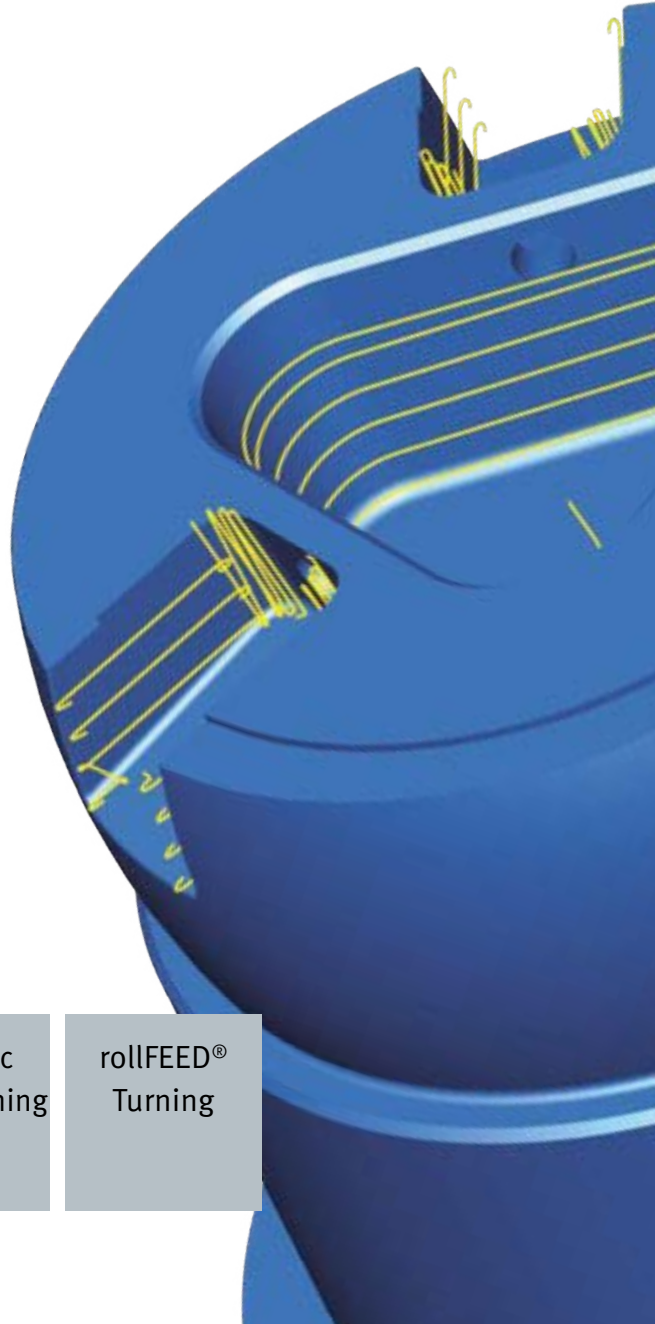
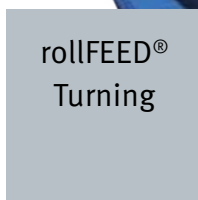
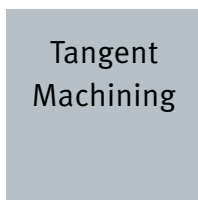
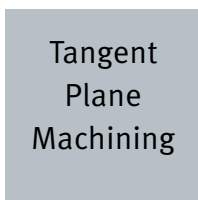
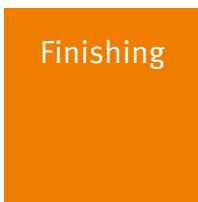
Finishing reinvented

High-performance machining even for surfaces

As one of the first CAM manufacturers, OPEN MIND has not only devoted itself to 5axis machining, but has also dealt with the issue of finishing with special tools and developed an exceptional package for this. The finishing module of *hyperMILL*® MAXX Machining offers high-performance strategies for the finishing of planes, surfaces with any continuous curvature, as well as fillets using different types of barrel cutters. Even when turning, a large cutting radius is perfectly exploited to increase performance. The enormous time savings and excellent surface quality result from the special cutting geometry of the tools and the perfectly matching CAM strategies.

■ **The various cutter types are available for many machining strategies:**

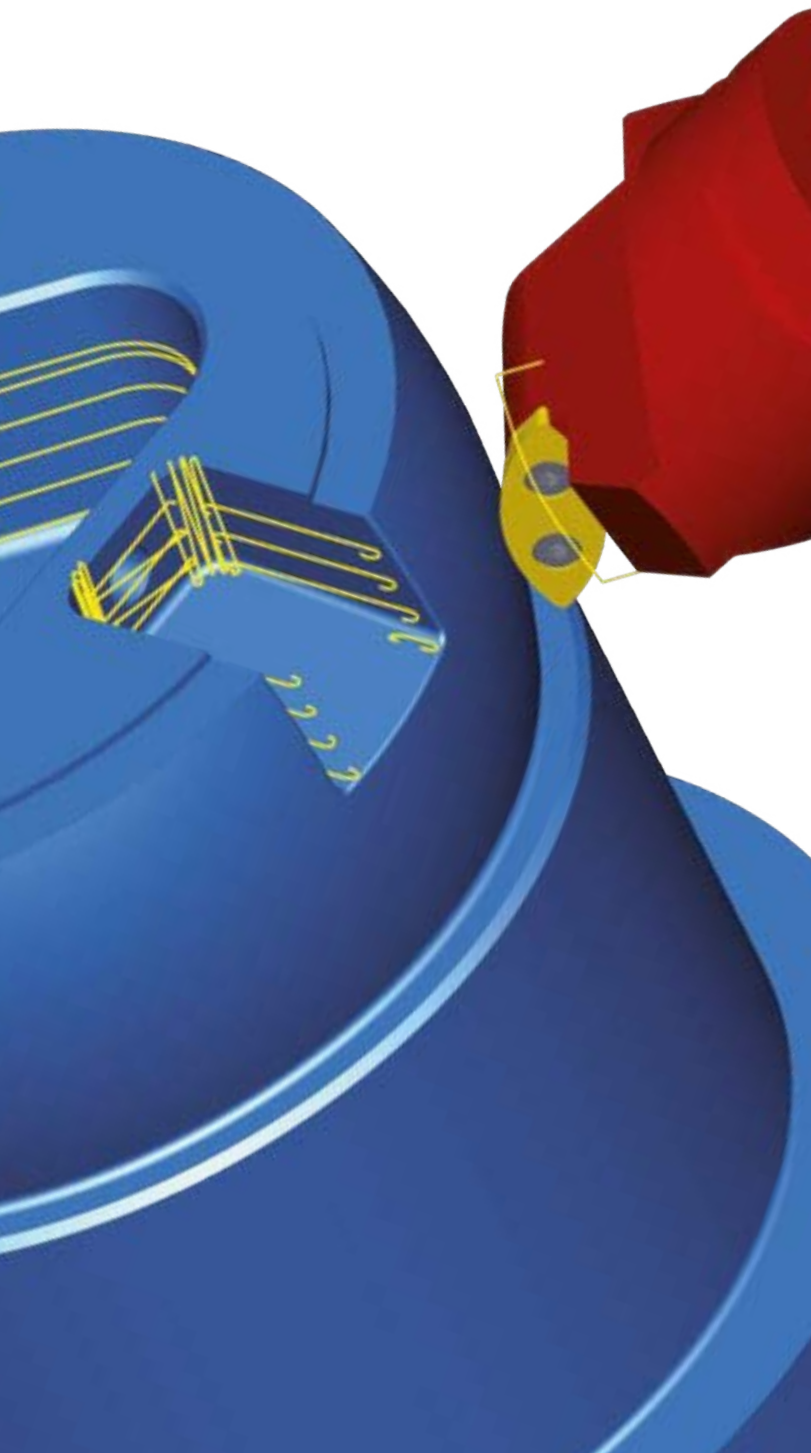
- 3D Shape Z-level Finishing
- 5axis Tangent Plane Machining
- 5axis Tangent Machining
- 5axis Prismatic Fillet Finishing
- 5axis Rework Machining
- 5axis Machining for impellers, blisks, and turbine blades
- 5axis Swarf Cutting



Possible applications

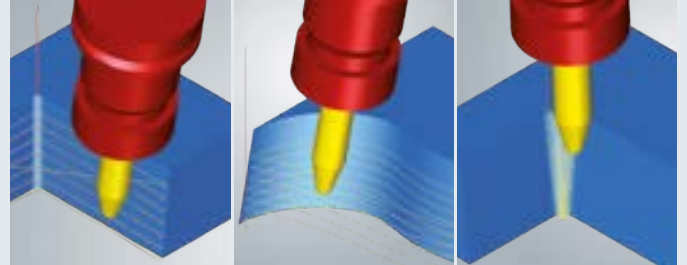
- Tool and mold making
- Production machining
- Aerospace
- Automotive
- Energy industries

Time savings of up to 90% during finishing



■ Milling

The tool geometry of barrel cutters cater to a variety of applications. *hyperMILL*® MAXX Machining offers innovative strategies that have been specifically developed for machining planes, free-form surfaces, as well as prismatic fillets.



■ Turning

OPEN MIND worked together with Vandurit to develop a machining strategy specifically for the rollFEED® turning inserts in order to make the best possible use of these turning tools. This means that very high surface qualities can also be achieved during turning in a short period of time.



■ Collision-free toolpaths

hyperMILL® MAXX Machining automatically calculates collision-checked toolpaths for 3axis and 5axis machines. In 5axis simultaneous machining, continuous adjustment of the inclination ensures reliable collision avoidance. This way, hard-to-reach areas are machined safely and efficiently.



Barrel cutter Tool technology

An OPEN MIND innovation

Barrel cutters with medium-sized cutting radii have been in use for many years. With its conical barrel cutter, OPEN MIND has developed a new type of tool that can implement very large cutting radii. It is the special shape of the tool that has made it possible to use such large radii in finishing both safely and efficiently. There are hardly any limits to machining with *hyperMILL*® MAXX Machining thanks to the perfect combination of tool inclination, fit of the tool to the component, and active collision avoidance.

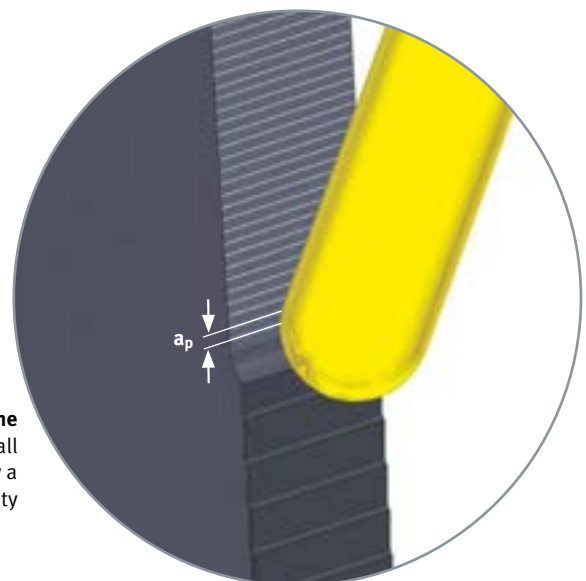
Short machining time

High stepdown with conical barrel cutter accompanied by a high surface quality



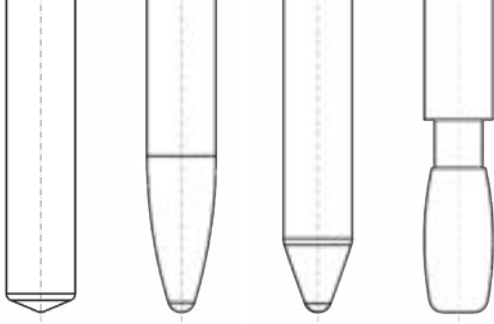
Long machining time

Small stepdown with ball mill accompanied by a high surface quality



Advantages

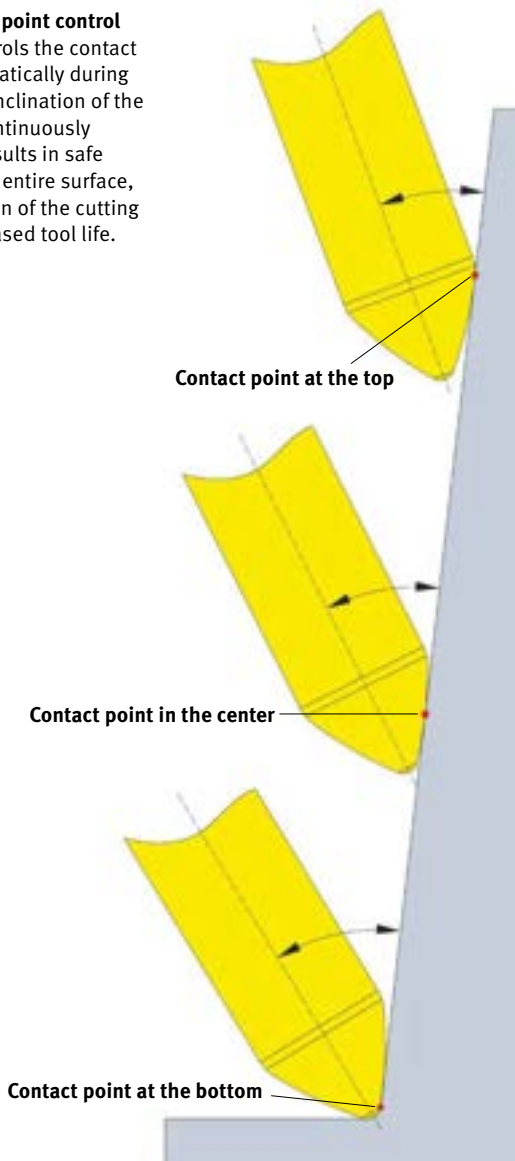
- Larger line increment with the same theoretical scallop height
- Shorter machining times with the same or better surface quality
- Longer tool life
- Axial deviations of the machine are smoothed
- Reduction in the number of tools; barrel cutters with a ball tip can be used simultaneously as barrel cutters and ball-end mills



NC tools

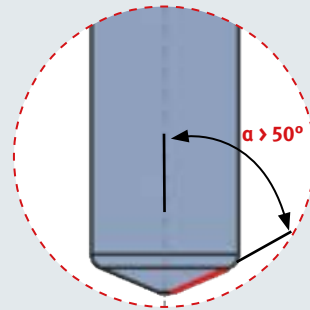
Any barrel cutter can be parametrically defined in *hyperMILL*®. It is not necessary to create free cutting geometries or design the milling tool based on 2D contours. Simple tool management and a CAM system that fully maps the barrel cutters ensure safe and reliable use of these tools.

Dynamic contact point control
hyperMILL® controls the contact point fully automatically during machining. The inclination of the milling tool is continuously changed. This results in safe machining of the entire surface, uniform utilization of the cutting radius and increased tool life.

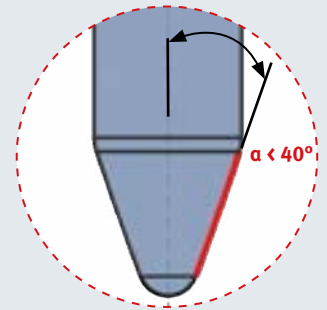


Cutting geometry

While general and tangential barrel cutters tend to be able to implement medium-sized cutting radii, the conical barrel cutter enables radii of 1,000 mm and more. The extremely large cutting radius makes it possible to achieve a large line increment and maintain fine surface quality.



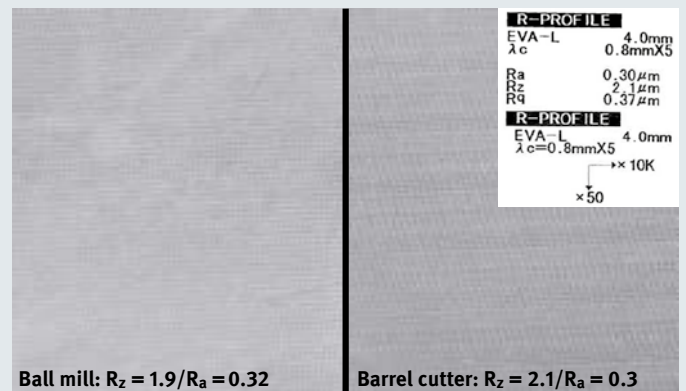
Barrel cutters with a conical angle greater than 50° are excellent for bottom finishing.



Barrel cutters with a conical angle of less than 40° are excellent for machining steep areas.

Surface quality

Compared to machining with ball mills, the theoretical scallop height does not change significantly with larger line increments. This was proven in real-life applications by means of surface testing methods. A reference surface was machined using a ball mill with a radius of 3 mm and a barrel cutter with a radius of 350 mm. While the quality of both surfaces was nearly the same, the machining time was 90 percent shorter using the barrel cutter.



Ball mill: $R_z = 1.9/R_a = 0.32$

Barrel cutter: $R_z = 2.1/R_a = 0.3$

Amortization

Barrel cutters allow a considerably larger stepdown/stepover to be used than with ball mills or bullnose endmills. This drastically reduces the machining time. In addition, the large cutting radii have a positive effect on the tool life. The shorter machining time and reduced wear on the tool permit very cost-efficient use of this tool technology.

Powerful CAM strategies

Performance boost for finishing

OPEN MIND has developed the innovative ‘Tangent Plane Machining’, ‘Tangent Machining’, and ‘Prismatic Fillet Finishing’ strategies specifically for the machining of planes, surfaces with any continuous curvature, and prismatic fillets. Compared to conventional methods, time savings of up to 90 percent can be achieved when combining the method with a conical barrel cutter. The strategies make optimal use of the benefits offered by the tool shape in order to achieve perfect surfaces during finishing. Intelligent automated functions ensure optimum tool inclination and fit. As a result, even hard-to-reach areas can be machined efficiently.

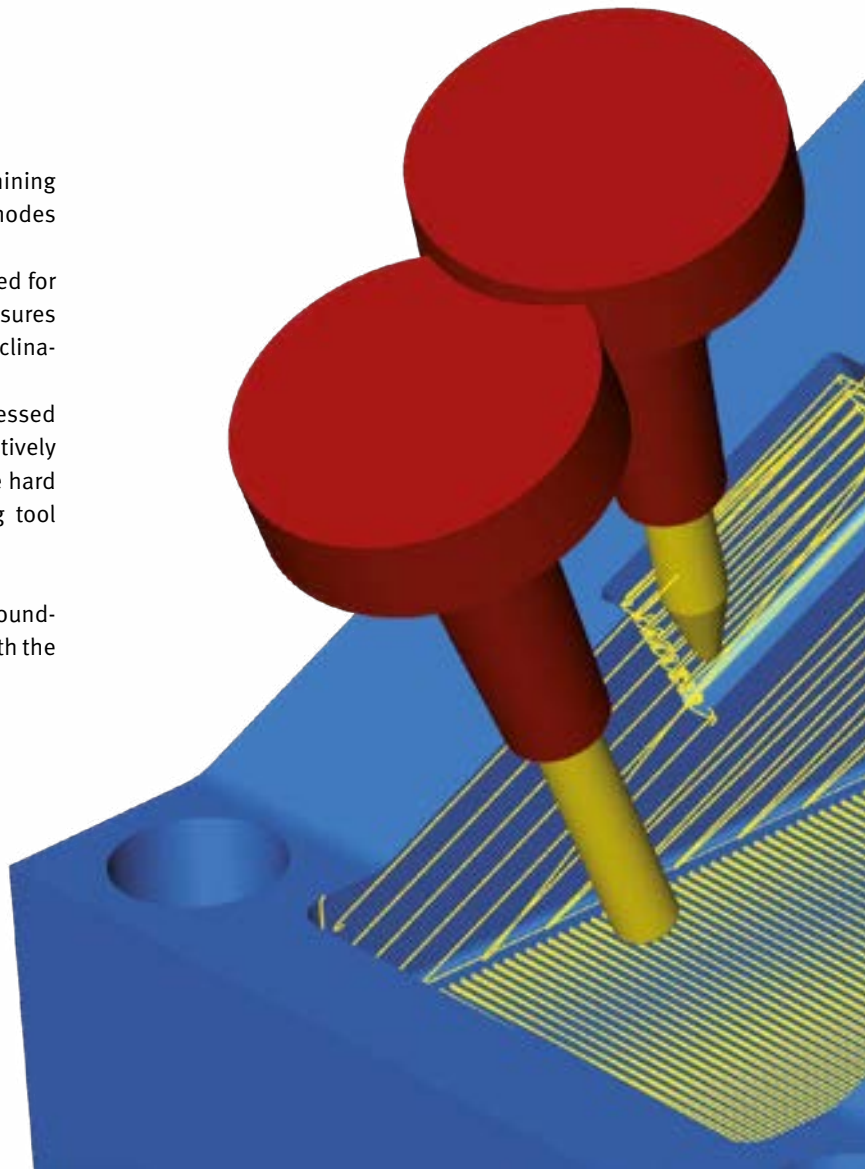
The high degree of user-friendliness is reflected in the simple selection of surfaces. The 5axis toolpaths are generated automatically and with collision checking when the user clicks the surfaces to be machined.

■ Tangent plane machining

A powerful strategy specifically designed for machining planar surfaces in wall and floor areas. Two machining modes are available:

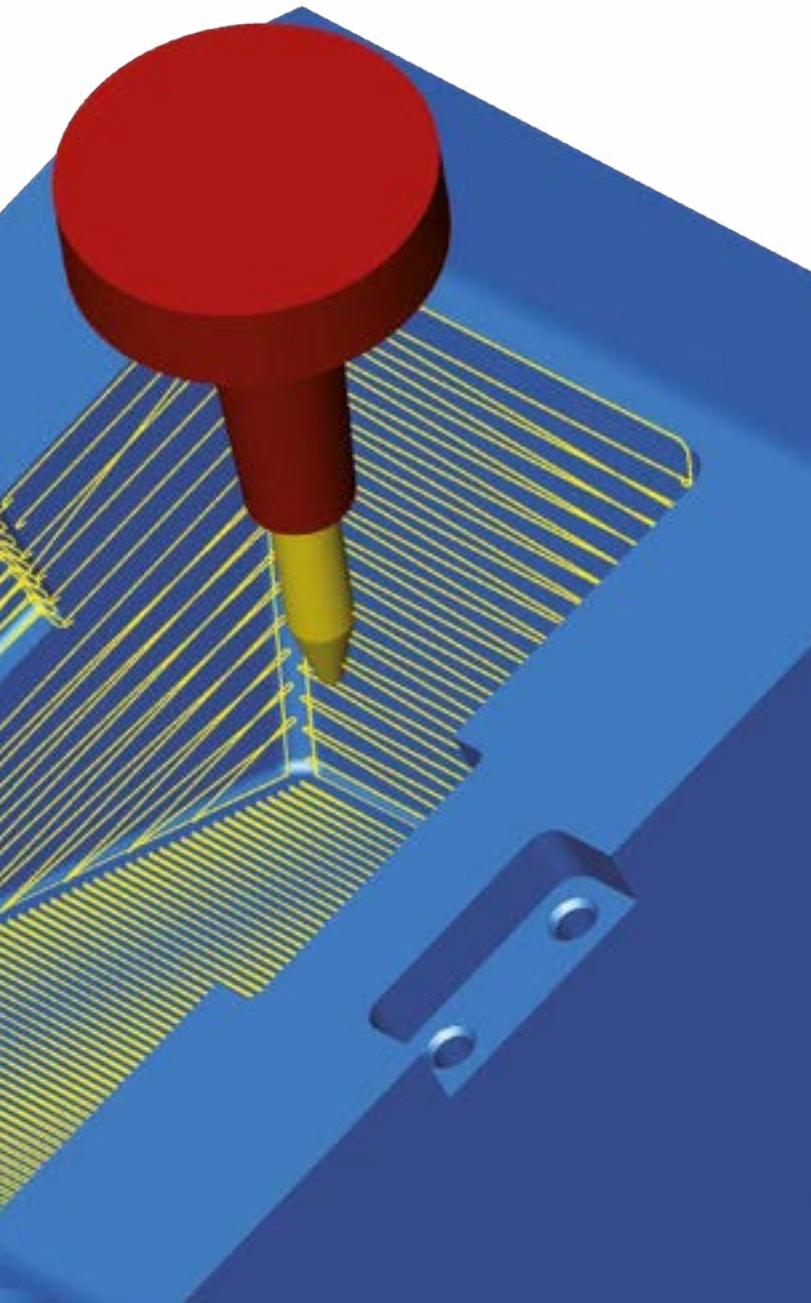
- In indexed machining, different inclinations are defined for the individual surface areas. Automatic overlapping ensures that a high surface quality is attained between the inclinations.
- In simultaneous machining, the entire surface is processed with 5axis simultaneous machining. The strategy actively helps to avoid collisions, particularly in areas that are hard to reach, by changing the inclination of the milling tool accordingly.

To ensure that the surface is machined completely, the boundary curves are also machined in one finish pass along with the surface.



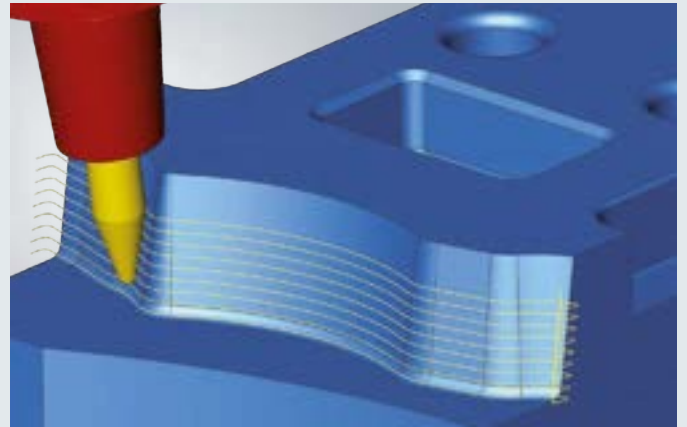
Features

- Especially suited for machining steep or flat planes
- Fully automatic machining of surfaces with any continuous curvature
- Hard-to-reach areas can be optimally machined
- Significantly larger line increment with the same theoretical scallop height
- Reduced number of tools



■ Tangent machining

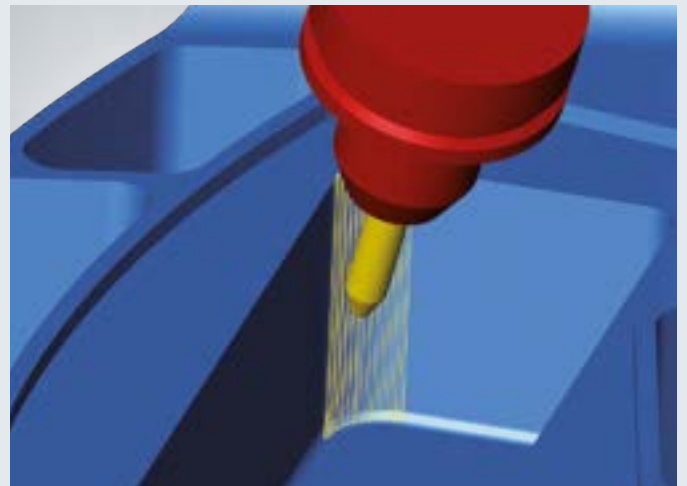
Surfaces with any continuous curvature can be machined efficiently with this strategy, as *hyperMILL*® generates the toolpaths fully automatically based on surface selection. Individual surfaces or a group of surfaces can be machined. Collision avoidance ensures that the tool tilts over the contact point of the milling tool. This allows the user to machine areas that are difficult to reach.



Multi-surface machining of several free-form surfaces

■ Prismatic fillet finishing

An extremely high feedrate can be achieved in plunging machining. Here, the inclined barrel cutter is used like a high-feed cutter. The strategy calculates the required inclination and contact point of the barrel cutter automatically. This allows users to create high-quality transitions between different surfaces, for example.



Machining a fillet between two surfaces

Diverse areas of application

Optimal use of potential

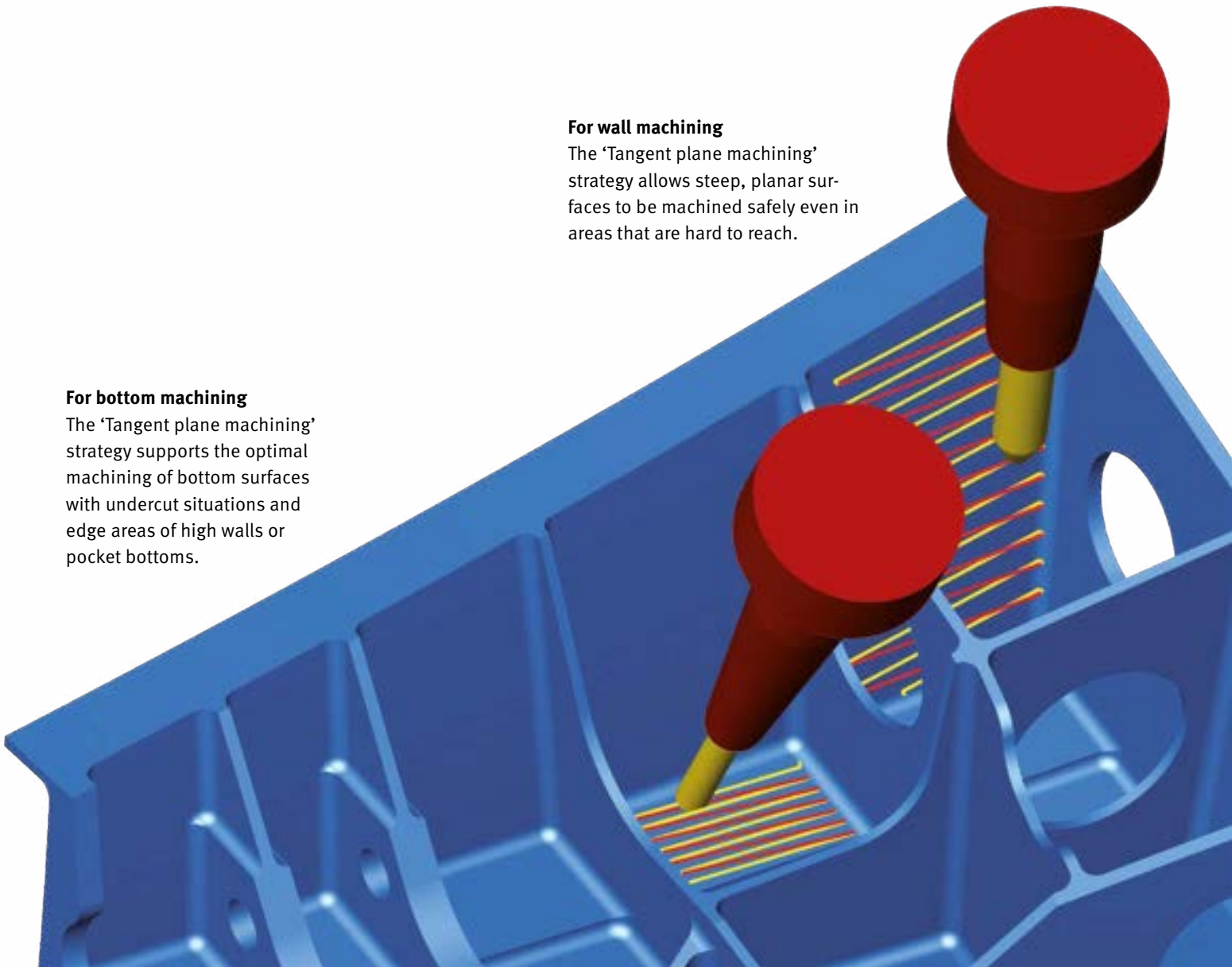
It is not only possible to use barrel cutters optimally on 5axis machines; they can also be used to maximum effect on 3axis machines. For example, inclined walls can also be machined efficiently if the cone angle of the barrel cutter corresponds to the inclination of the wall. During machining, the transitions between the individual line increments are perfectly smoothed, and an excellent surface quality is achieved. Indexed machining allows barrel cutters to also be used on less dynamic large machines. This significantly reduces the machining time. *hyperMILL*® supports the various types of barrel cutters in numerous strategies so that the tools can be used in a wide variety of applications. Machining is always carried out efficiently, without collisions, and with the highest quality.

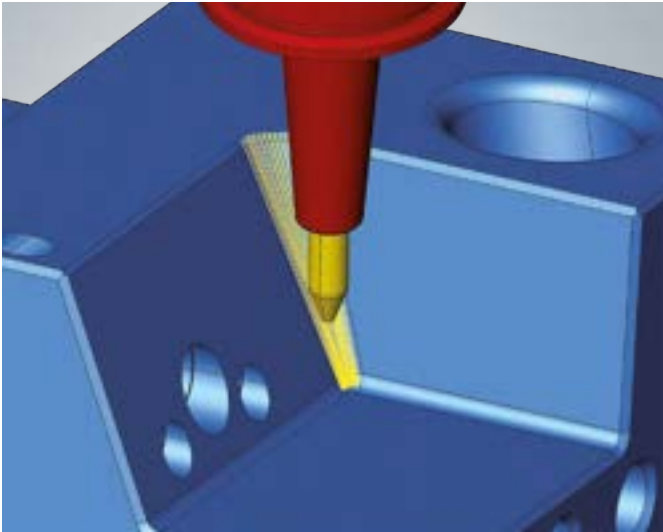
For wall machining

The 'Tangent plane machining' strategy allows steep, planar surfaces to be machined safely even in areas that are hard to reach.

For bottom machining

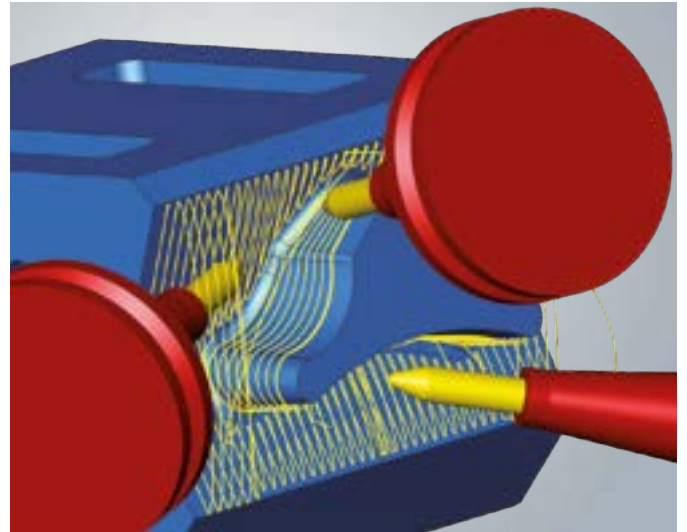
The 'Tangent plane machining' strategy supports the optimal machining of bottom surfaces with undercut situations and edge areas of high walls or pocket bottoms.





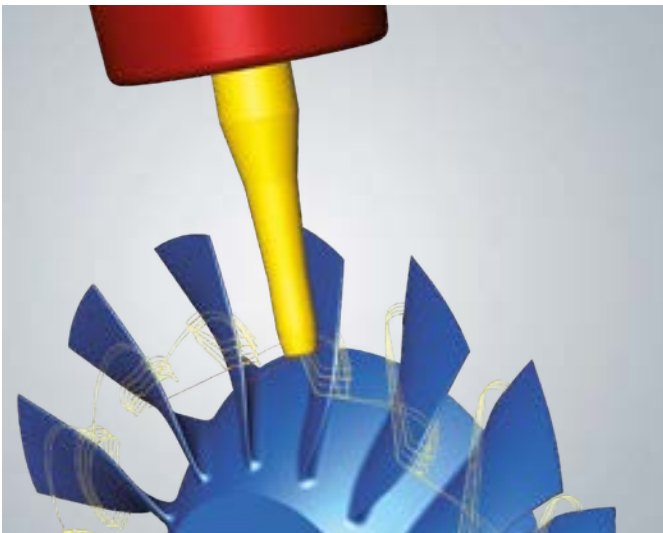
For fillets

The 'Prismatic fillet finishing' strategy allows fillets between surfaces to be finished very efficiently. This strategy perfectly complements the machining of deep pockets with barrel cutters.



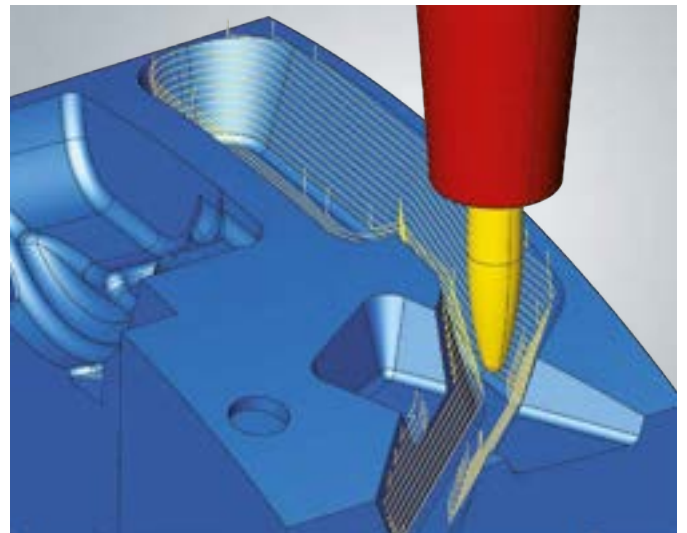
For free-form surfaces

The 'Tangent machining' strategy allows surfaces with any continuous curvature to be machined individually or in a group of surfaces. Thanks to a simple surface selection, there is no need for any time-consuming generation of cutting contours in the CAD system. *hyperMILL*® automatically calculates the inclination and fit.



For blisks and turbine blades

Barrel cutters can also be used efficiently in special applications such as the machining of blisks or turbine blades. Although the cutting radii are smaller, the infeed can still be increased many times over compared to machining with a ball mill.



In 3axis machining

Walls can also be machined efficiently on 3axis machines if the cone angle of the barrel cutter corresponds to the inclination of the particular wall.

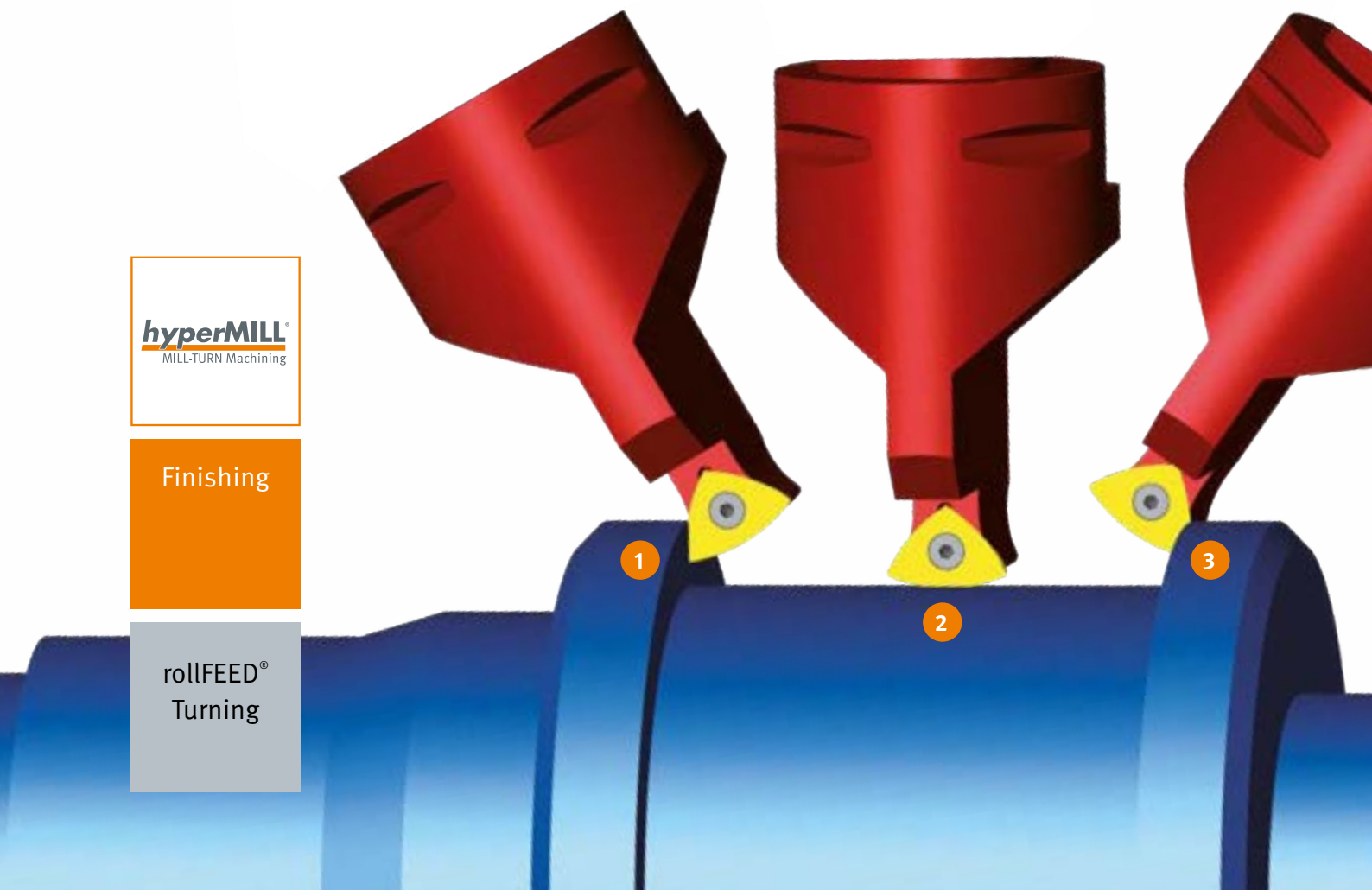
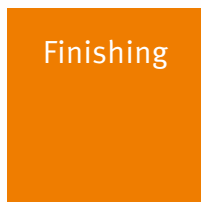
Highly efficient finishing

Turning has never been faster!

Thanks to the innovative rollFEED® turning inserts from Vandurit and the perfectly adapted *hyperMILL*® rollFEED® turning strategy, flawless workpiece contours can be achieved in no time at all. This unique turning method is based on a rolling movement of the tool insert on a workpiece surface of any shape. The large radii of the insert, ranging from 17 to 19 mm, allow a much higher feedrate and greater cutting speed than with conventional inserts while maintaining or even improving the surface quality.

Machining grooves with a single tool

When grooves are machined, the tool is automatically guided from the first to the second plane level via the cylinder surface. This enables highly efficient machining with a single tool in a single movement, and thanks to the combination of roll and turn movements, even workpieces with large radii can be machined reliably.



Advantages

- Highly efficient process
- Perfectly finished surfaces without any twists
- Simple to program
- Fewer tool changes
- Undercuts can be integrated into rolling movement
- Tool life extended by a factor of three to five

Areas of application

- All materials can be machined
- All cutting materials can be used
- For inside and outside machining
- Diverse applications: for plane levels, cylinder, convex, and concave surfaces as well as for inclinations and grooves

- 1 Side rolling
- 2 Bottom rolling
- 3 Side rolling

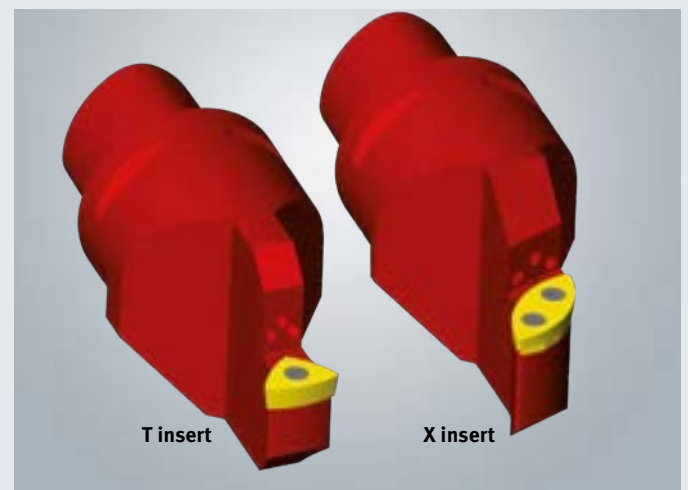
rollfeed[®] **TURNING**
by vandurit

■ Exclusive partnership

In collaboration with Vandurit, OPEN MIND has developed an exclusive and perfectly matched CAM strategy for Vandurit's innovative new rollFEED[®] turning process.

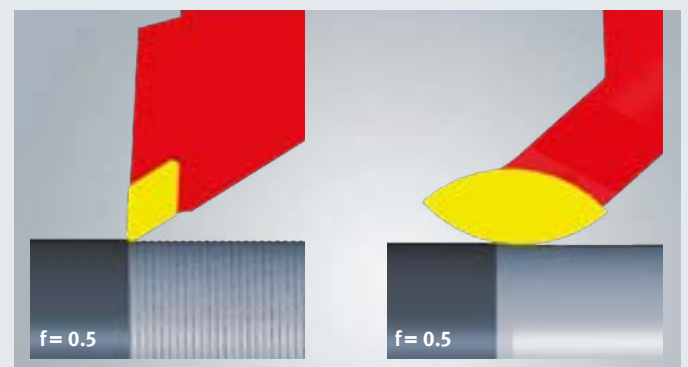
■ rollFEED[®] turning indexable inserts

Only two rollFEED[®] indexable insert geometries are required for turning operations. The T insert is suitable for machining up to three component sides, and the X insert is suitable for machining up to two component sides.



■ Perfect surfaces with high feedrates

At high feedrates, the rollFEED[®] turning indexable inserts achieve a significantly better surface quality than conventional inserts with a radius of 0.4 mm or 0.8 mm. The improved cutting conditions also extend the life of the tools by a factor of three to five.



High feedrate:
poor surface quality

High feedrate:
very good surface quality

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hyperMILL[®] MAXX Machining – HPC
 based on

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We push machining to the limit

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