num information

num®
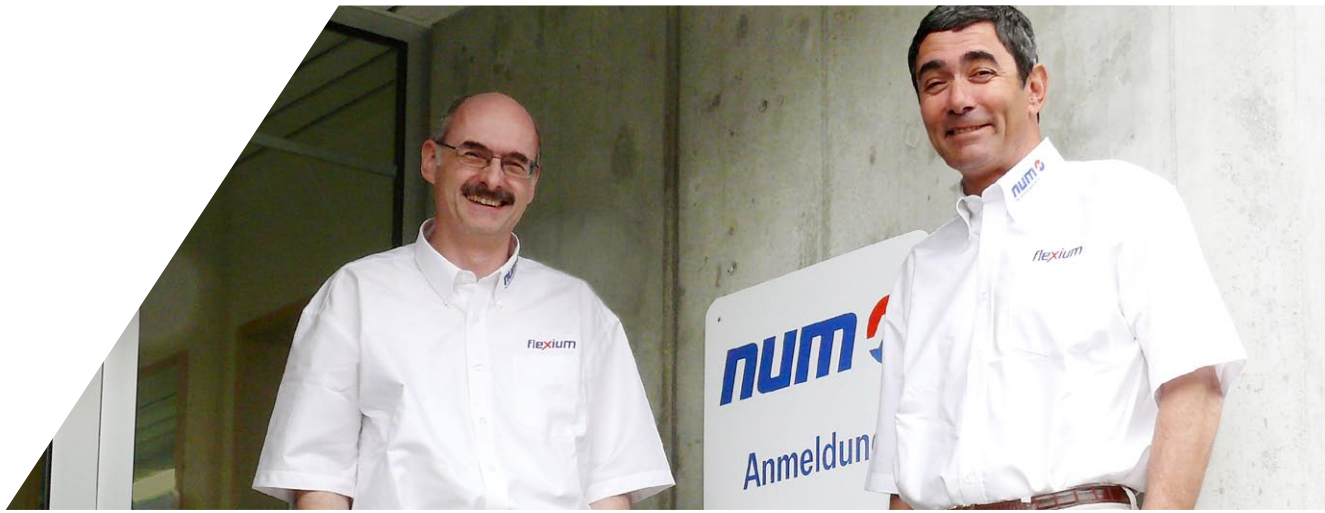
NUM production plant in Cuggiono/IT:
Comprehensive conversion provides
more quality and flexibility

Words from our Chairman and CEO

Dear Reader

More than 10 years before the CNC control was starting to become widely accepted, the first NUM CNC controller was developed in 1964 making NUM one of the first in this market and we have strived to maintain our position as a technology leader in this segment ever since.

Our market strategy is to help our current and future customers to construct a better machine and thereby securing them a competitive advantage on the market. As can be seen from our logo we perceive ourselves as a CNC High-End Application company and we are focusing on selected market niches, where we undeniably have something extra to offer, and we have a proven track record to back up this statement.

Headquartered in Switzerland we currently have more than 35 sales and service locations located around the world, an international company with worldwide activities.

Our R&D facilities are located in Switzerland, France and Italy, where we also have our major manufacturing facility. It is our clearly defined strategy to have the development and manufacturing of the core products in a CNC system, including drives and motors under our own control to enable us to enhance the total CNC system performance. When this is said, we also integrate and take responsibility for 3rd party products in specific solutions in close cooperation with our partners and customers making NUM a true one stop shop for High End CNC solutions. The success of our partners and customers is the measure of our success and directly the justification of our position on the market.

Total cost of ownership is increasingly becoming a challenge for our OEM customers and End Users so we are dedicated to a high quality and

> **Mission Statement:**
>
> **NUM CNC solutions provide Machine Builders with a competitive advantage**

the reliability of our products combined with an effective and responsive world wide after sales service organisation.

NUM is in a very positive development and has a strong financial position. We are dedicated to the CNC market and will continue to invest in technology, production, support and service with a long term perspective and thereby remain an attractive partner for our current and future customers.

Franck Ullmann
Chairman
(right)

Peter von Rüti
President & CEO NUM Group
(left)

numhsc®

HSC? It's as easy as driving Formula 1!

Einstein used to say, "Everything should be made as simple as possible, but not one bit simpler." The same could be said to apply to machine tools: "Every workpiece should be cut as fast as possible, but not one bit faster."

High-speed cutting of workpieces guarantees productivity and profitability of investment. Yet going too fast may compromise production quality.

Continuing with our analogy of a numerical control and a car, let's take a look at the various HSC functions on the NUM numerical control.

with long straight pieces with gentle curves or maybe you have short sections with sharp angles?

Speed versus accuracy

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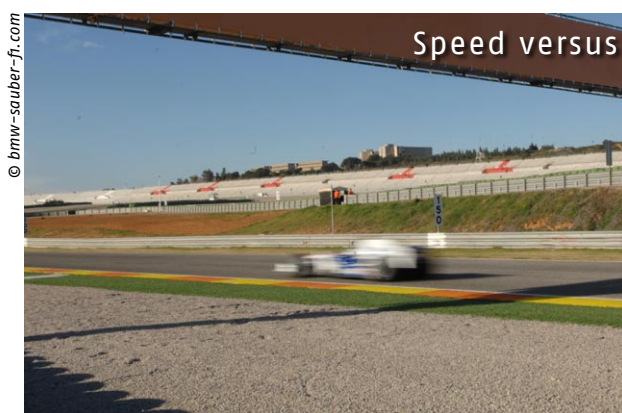
NUM numerical controls contain all the functions required for optimum control of your machine so that a trade-off between productivity, precision and quality can be reached which matches your own objectives:

- Look ahead – preparation of CNC blocks
- Automatic deceleration on recognition of key features of profile
- Jerk-controlled gradual acceleration
- High contour precision with zero following error
- Smoothing and compressing of CNC program

Quite possibly you're thinking, "My machine is well designed and well built. Its servo drives are well-tuned to the motors and are perfectly controlled. The machine axes respond dynamically and are stable. So what would I need all these parameters in the numerical control for?" However... a machine tool is very much like a car. You can have the best car in the world but your speed and the comfort of your passengers primarily depend on your driving skills, the state of the road and traffic conditions.
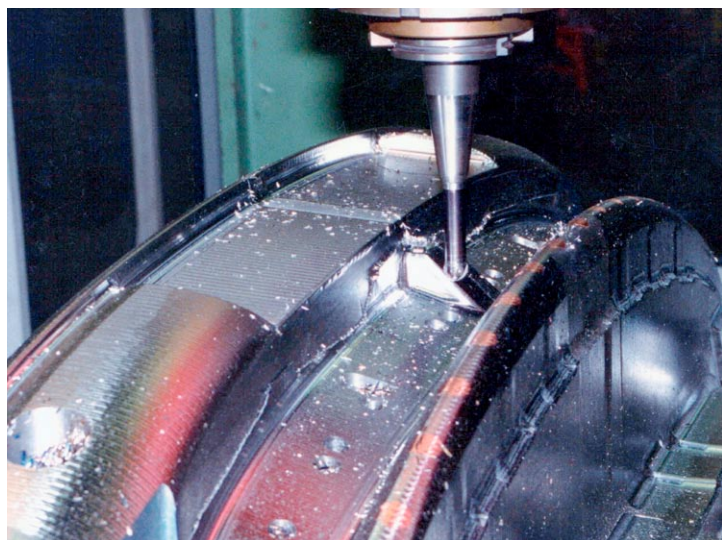
Look ahead – Preparation of CNC blocks

If a racing car or a machine tool only ever had to deal with straight lines at high speeds, there would be few difficulties. But when you need to stay on a circuit or on a part profile on curves or corners, speed becomes problematic.

A driver will have a mental image of the circuit in his head. He knows when to change gear and brake before entering a curve. If he waits until he's on the curve to decelerate, it will be too late and he'll exit the track. The ISO programs which describe workpieces are the CNC's circuits. The CNC needs to recognise the profile of the piece and make notes on them before they can be cut. Maybe you work

But the CNC doesn't need to recognise the program several days beforehand – it carries out its preparatory work at the same time as it cuts the workpieces. A part of its computing power is therefore spent on analysing the program blocks and determining the dynamic conditions under which it can execute them.

But how do you tune the parameters of the look ahead on a NUM CNC? Well we've some good news for you here – you don't need to do anything because there are no parameters for the

Parts are racing circuits for the CNC.
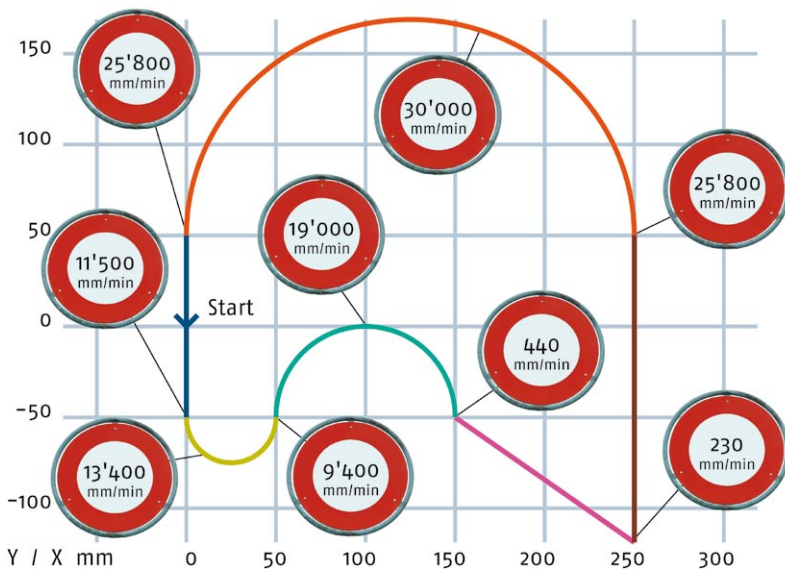
Look ahead:
bloc preparation and pacenotes

look ahead! The CNC automatically computes the number of blocks it requires to perform the look ahead.

We think it's good to explain the physics behind these computations to users of our CNCs: the kinetic energy of an object changes according to the amount of work performed on it. For a displacement with constant acceleration and zero velocity at start time, the relationship between distance travelled, velocity and acceleration is calculated as follows:

$$L = \frac{V^2}{2\gamma}$$

This formula can be applied to all types of machining – even where the machine does not have a NUM CNC!

This relation is familiar to us from the steering wheel of our car: to accelerate, we need some free space and, importantly, the braking distance is squared in relation to the speed. For the CNC, this means it needs to compute a sufficient machining length to attain and maintain the specified feed rate. For example, with an acceleration of 5 m/s², 10 cm is needed to attain a rate of 60 m/min.

CNC programs for free-form surfaces usually consist of simple line segments. The greater the precision required, the smaller the blocks programmed. For example, to describe a circle with a radius of 10 mm to the precision of a micron, 200 segments of less than 0.3 mm need to be used. In order to go fast, the CNC therefore needs to be capable of preparing a large number of blocks per second.

On this basis, NUM numerical controls are very high-performance. They
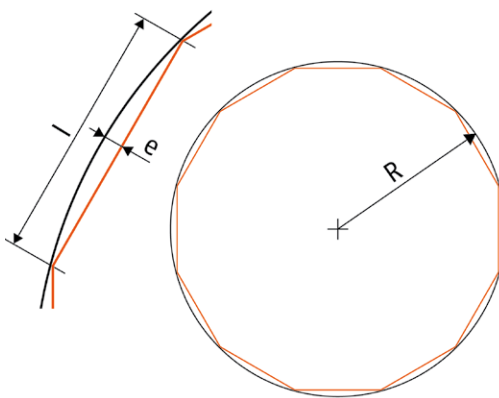
adapt automatically to the calculation requirements and are capable of preparing and executing several blocks per sampling point period.

Automatic deceleration on recognition of key features of profile

Like a driver on a circuit, the CNC knows how to negotiate the various difficulties of profiles. It knows how to recognise not only angles and curves but also changes in curves during a series of bends. Where a long segment is programmed in polynomial or NURBS, the CNC analyses the profile

along the length of the segment that needs to be cut.

The CNC modulates its feed rate along the course according to the precision target you specify. You can modify your precision criterion any time during the roughing or finishing phases of course. This enables you to obtain an ideal balance of productivity and precision.
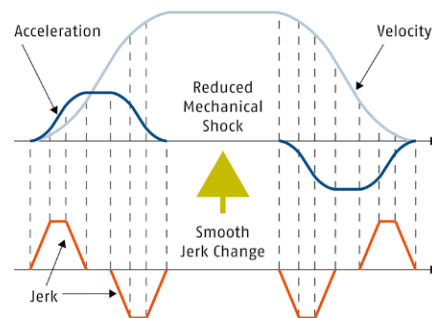
Jerk-controlled gradual acceleration

Let's leave the subject of speed now to deal with the subject of comfort. When the machine accelerates or changes direction, there is a point that the machine goes from zero velocity to some velocity, and when it gets up to speed, it goes from accelerating to steady speed. This acceleration change can jolt the machine slightly and limit optimum machine performance. To keep this jerking to a minimum, you need to turn on the jerk-controlled gradual acceleration functions of the CNC.

With NUM CNCs you can regulate a profile using smooth bell-shaped acceleration. This means it controls the jerking or vibration due to the change in acceleration. This is precisely the

numhsc
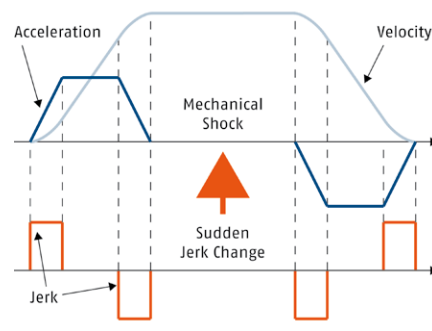
same parameter you control when you press gradually on the accelerator or brake to increase the comfort of your passengers when driving.

To make gradual acceleration control simpler, NUM uses time parameters. Acceleration time and jerk time. In fact, scientific research has shown that vibrations are reduced enormously when the acceleration time equals the period of dominant non-rigid mode for the machine.

High contour precision with zero following error

After the preparation phase, we can guarantee that the part can be physically cut by the CNC at the speeds set by the look ahead. There's no need to use additional filters since the CNC takes all physical constraints into account beforehand. The high contour precision function allows dynamic errors caused by the servo drives to be compensated for and guarantees as few profile errors as possible.

Smoothing (NUMLiss) and compressing of CNC program

We have all experienced the pleasure of driving on a smooth, clear and evenly-marked road. NUM has now developed NUMLiss, a smoothing and compressing program that improves your ISO programs to increase the quality of cut workpieces.

The CNC program is the result of the CAD/CAM process: CAD 3D geometry model of the workpiece, toolpath generation by the CAM system, translation into the specific instructions required by the CNC machine by the post-processor. Each step is the cause of some minor geometric deviations
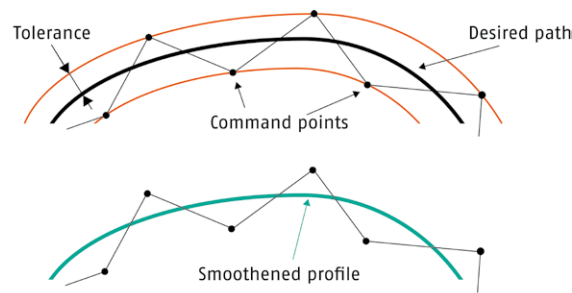
NUMLiss:
Smoothing and compression of NC programs

from the original model. In particular, the CAM system can negatively affect the quality of profiles when it processes its machining strategies: clouding of points where changes have been made to the surface of the CAD model, points which are too close together that do not return any pertinent geometric data, artificial chatter marks due to distribution of the points on both sides of the initial CAD model and so on. This is the most frequent cause of problems encountered with the machine and may result in unwanted reworking.

The toolpath provided by CAM depends on discretisation parameters. If these have been selected incorrectly, processing by the numerical control

may be problematic. By treating the ISO program with NUMLiss, the result will be a shorter, smoother program meaning you obtain your piece more quickly and with a better surface quality.

The numerical control is nothing without the know-how of its operator!

There is always a trade-off between speed and accuracy. High-speed machining can improve both these parameters simultaneously but the HSC can only be optimised for one of them. And the operator has a key role to play in this!

The operator has to understand the effect of the CNC's HSC parameters so that they can be set optimally for the different machining phases. The experience of the operator is irreplacable when it comes to judging the quality achieved and getting the most from the machine and its NUM numerical control.

Serge Bloch, NUMhsc

Easily visible: the much better surface quality with NUMLiss (bottom).
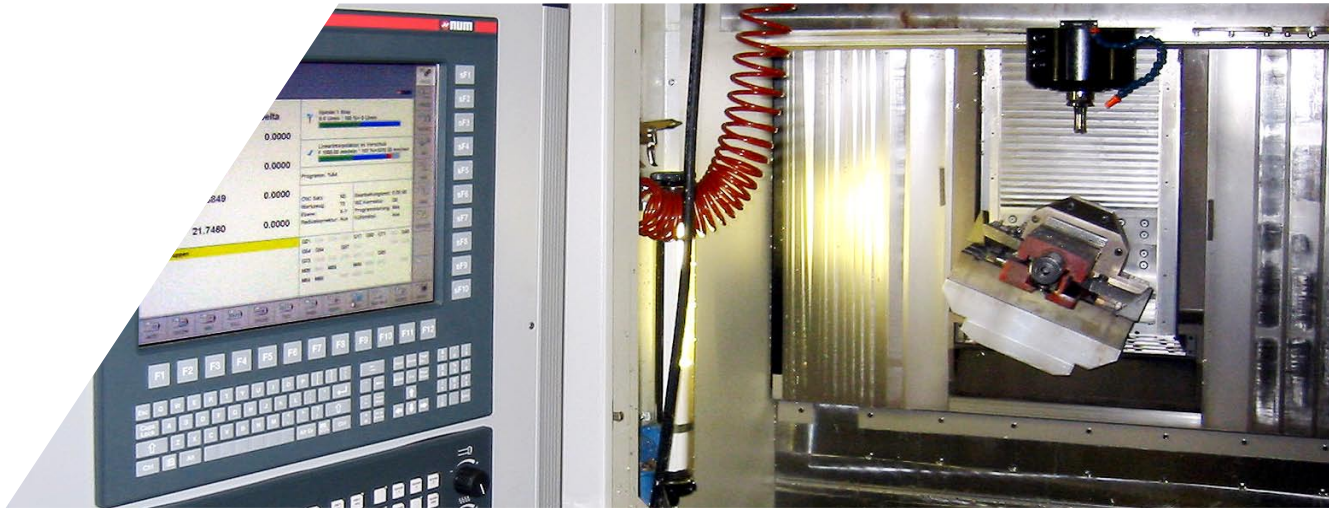
Production Research:
Highest dynamics and precision in series production

The best processing machines currently existing provide production research with the basis for further technological leaps. The accuracy and speed of a test machine made by Anger, equipped with NUM, was enhanced, tested and has now come into operation for ongoing research projects.

Profactor Produktionsforschungs GmbH, based in Steyr, Austria, is working on production technology for the future. The production of composite materials such as magnesium/aluminium, steel/magnesium or plastic/wood, is a central area of concern. Just as important is the research into the cutting of titan, titan-aluminid, cobalt and nickel alloys, or micro-cutting using tool diameters of less than 0.02 mm.

For the cutting trials, a 4-axes-processing unit made by Anger GmbH from Traun, Austria, was set up with a NUM control unit. The machine features up to 24 spindles and the workpiece is moved from one fast-mounted spindle to the next during the production cycle. This indicates a span-to-span best-time of just 0.3 seconds. By eliminating the need for the tool changeover, the secondary processing time is also minimised, since the time-intensive deceleration and acceleration of the spindles becomes redundant. The tool remains positioned exactly in the tool fitting, attaining the highest accuracy: process-enabled positioning tolerance of 0.01 mm, diameter tolerance in the area of IT 5 and cylindricity of up to 0.002 mm.

The introduction of stable high-speed spindles with rotation speeds of up to 160,000 rpm broadens the research areas at Profactor. Using the NUM control unit, both a very high machine dynamic in 3-axes simultaneous cutting, as well as the integration of 6-axes micro-positioning systems, can easily be realised.

Test contours for realistic dynamic testing

"We would like to know how fast a machine can cut parts, and not read the manufacturer's catalogue values on a machine's maximum acceleration and acceleration speed" comments Franz Obermair, Head of Manufacturing Technology at Profactor and adds illustratively: "If I want to stay in a hunting lodge in mountains, I'm not going to drive there in a sports car. It would have a high maximum acceleration, however I could get around more quickly and safely in mountain-

Science
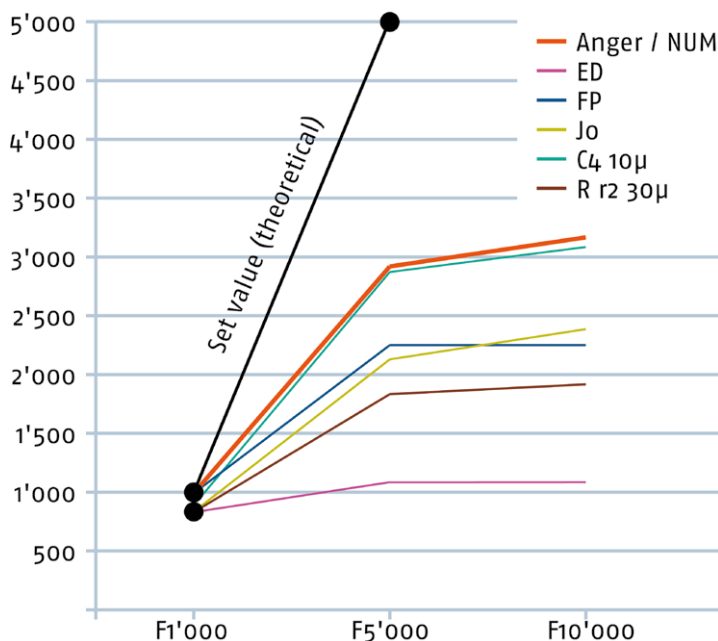
Actual feedrate (X-axis) attained to programmed feedrate (Y-axis): Anger/NUM can convince with the best figures in practice.

ous terrain using a good four-wheel drive."

For the test, a 100 × 100 × 100 mm large aluminium block was used, into which the test geometry was to be cut. The test block was processed using feed rates of F1'000, F5'000 and F10'000 mm/min. This contour had already been cut using several other machines and the results are presented in diagramme 1.

The machine names in the illustration have been obscured, and the Anger HCP with NUM-controls is displayed in orange. The maximum contour deviation always remained under the stipulated 0.01 mm. The average feedrate attained via the contour is important, as it reflects the processing time for similar parts.

"Using the NUM control unit, excellent dynamic values could be attained during its first implementation. They are among the best and after a few test runs and further optimisation,
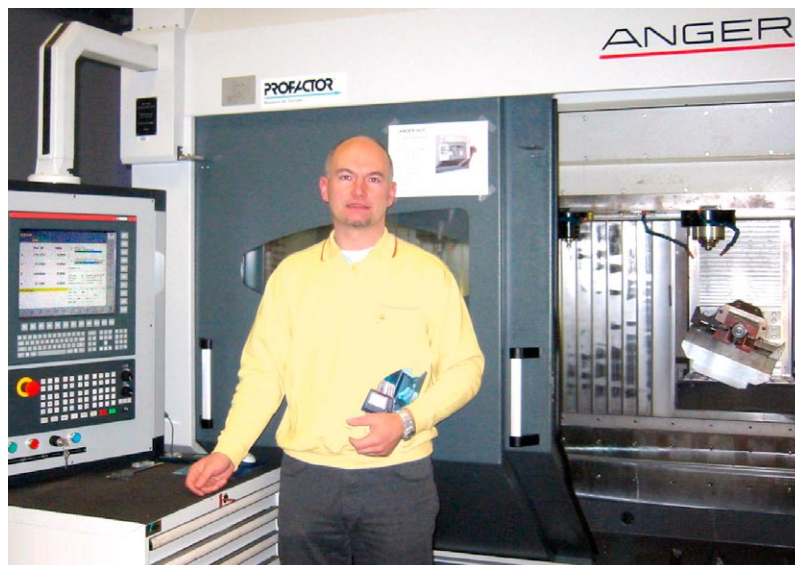
they even exceeded it." Franz Obermair explains the results shown in the diagramme and concludes: "The precision of the test contour was better than that of the competitors."

Thanks to the good results, Profactor can now proceed with demanding new

research projects in micro-cutting and precision processing, and develop appropriate processing strategies.

Worldwide

EMO 2007: A resounding success for NUM

NUM's presence at the EMO 2007 was characterised by the biggest product launch for years: the completely new, comprehensive Flexium CNC system with new CNC, user interface, SPS, inputs and outputs, servo drives, motors and programming software. The generously spaced stand was very well frequented and the interest shown in the Flexium CNC system, as well as our solutions, systems and products, was well above expectations. The success at the EMO 2007 is a substantial factor for the continued, positive development of the NUM-Group.

GrindTec 2008: 20 years of NUMROTO

Over two decades in which machine manufacturing has undergone considerable changes, NUMROTO has firmly established itself as the trendsetter in tool grinding it is today considered to be. At this year's GrindTec we celebrated 20 years of NUMROTO and the stand was correspondingly well attended. Our technical experts were demonstrating new functions and innovations non-stop – the GrindTec was a resounding success.

Comprehensive conversion
provides more quality and flexibility

The NUM production plant in Cuggiono has been almost completely reorganised over the last three years. Mechanical engineers and end customers clearly profit from the extensive improvements to the areas of production, logistics and repairs.

An intrinsic characteristic of NUM is their consistent customer orientation and focus on the applications they use. No other supplier combines intensive, needs-driven and flexible cooperation – when requested, even far into the machines and applications – with their own comprehensive and high-grade CNC unit and drive products.

In order to be able to satisfy to the high demands involved, extensive improvements were tackled in the areas of production, repair and logistics at the NUM production plant in Cuggiono, Italy. Parallel to that, the production of a number of products previously manufactured at diverse locations in Europe w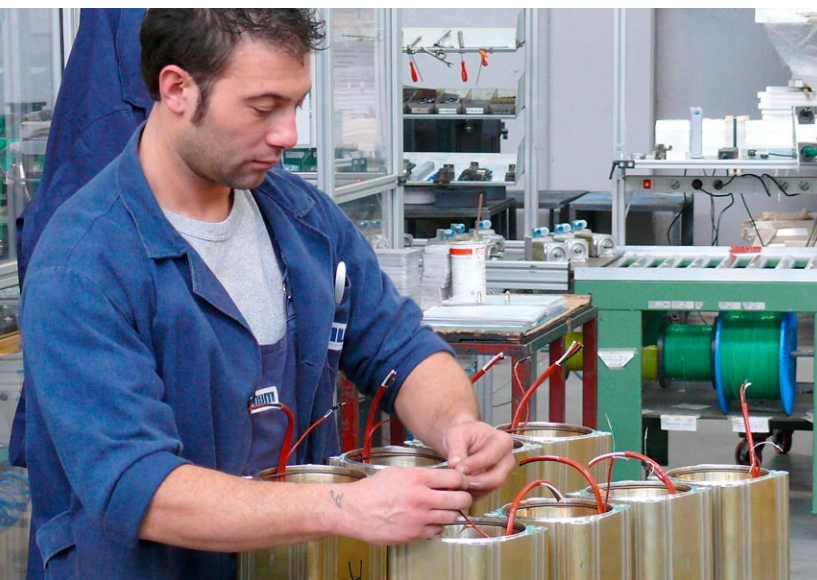as relocated to Cuggiono. Due to the exacting analysis of workflows and methods in all areas, new and significantly shorter production processes could be specified. The entire logistics and the suppliers were also factored into this inspection. In the three years since the project commenced, the entire production has literally been turned on its head.

Maurizio Zoia, Production and Logistics Manager, mentions several facts: "With the Lean Manufacturing Programme we could, for instance, significantly increase efficiency in the production of the axis motors. Using only half the space we today manufacture 44% more motors, furthermore doubling the output per employee." The conversion from production lines to production islands created a lot of free space, as can be seen in the picture above. Three new production islands are being set up in the vacant area, which NUM will be using for the industrialisation of diverse new products.

Flexible and on schedule

While the old production lines for axis motors have remained unchanged for decades, three modifications have already been made to the new production island within two years. Today, we check that production proceeds safely, and an enterprising mindset has emerged among the employees. This becomes evident in the fact that the internal detection system for improvements to production and prod-

uct quality is being actively used, benefiting NUM's customers directly.

On one hand, the product quality has improved significantly and the failure rate is now extremely low. On the other hand, the production is very flexible and is continually modified to suit demands. Originally, the time until delivery took approximately 6 to 8 weeks, while it now amounts to just three weeks (ex. factory; customers are served via the buffer stock). Just as important for the customer is a definite delivery date: over 96% of deadlines are met exactly on the day.

"The involvement of all parties concerned and their active support of the project ensured that we could reach our goals in the specified time. Today we have a committed task force which operates with high flexibility and customer-orientation," praises Maurizio Zoia his co-workers.

**Replacement parts:
available fast and reliably**

At the same time as the improvements to production, the central replace- ment part store for the NUM group was set up in Cuggiono, located west of Milan. Apart from easy availability, the proximity to Malpensa Airport guarantees the speedy delivery of spare parts to the customer.

"As a rule, a replacement part for our CNCs, drive amplifiers and accessories leaves the plant within 24 hours," elaborates Maurizio Zoia. Even non-standard, customer-specific motors from the current product range are repaired extremely quickly or even remanufactured, which allows machine downtime to be reduced to a minimum. "Our customers value our spontaneous engagement and the speed with which we realise ideas" concludes Maurizio Zoia.

New repair concept

Hans-Peter Hofmann, General manager of the NUM Company in Italy, has a lot of plans: "We want to establish the NUM Group's competence centre for repairs in Cuggiono, and to offer the customers an even more flexible and professional service." In the future a three-step scenario should provide the customer with optimised service. At the forefront are the country and service representatives, who undertake the first intervention.

If a solution cannot be found, then the product is taken to Cuggiono, where even the most difficult cases can be dealt with. If the problem is complex, the third step sees even research and development being called in by NUM and initiating any development project required. This immediate proximity to both customers and production guarantees that our products can be improved and enhanced speedily and in step with actual practice.

Professionalism, quality and flexibility are qualities which are seldom found in the same combination. This is how NUM Cuggiono helps our customers to hold their own in the marketplace.

Kennametal:
Congratulations on the 100th machine using NUM!

100 machines equipped with NUM at the one location – Kennametal utilises the flexibility of NUMROTO and the collaborative venture with NUM for precision and efficiency in production.

Kennametal's functional, well-tended factory building bordering a residential area in Vohenstrauss, Germany, hardly gives a clue to what it holds inside. Alone the view of the first production hall is impressive: numerous tool sharpening machines equipped with NUM CNC-controls are accurately lined up, side by side. There is a momentary déjà-vu on the long way through the second into the third production hall, and by the end of the corridor the visitor can count exactly 100 machines!

Kennametal Vohenstrauss specialises in the production of standard and customised tools as well as the development of new tools and types. 8,000 precision tools are manufactured on these 100 machines every day, of which 2,000 alone are drills of 3 to 25 mm in diameter. Despite this, the noise level is pleasantly low and the light, orderly surroundings convey a sense of high professionalism. This comes as no surprise, as the specialists have been building up their comprehensive, fundamental theoretical and applicational knowledge since 1985, when they were still known as Hertel GmbH.

20 years of close cooperation with the specialists from Kennametal has contributed to the ongoing success of NUMROTO. Josef Braun, Standard Production Manager, explains: "We know every detail of the software and fully utilise its functionality and flexibility, and provide feedback accordingly. This way we can satisfy the growing demands on the tools and therefore also their diversity and complexity." The production also becomes economical thanks to diverse functions such as measuring-in-process or the 3-D simulation with collision detection. This allows, among other things, an employee to attend to five machines at the same time and still deliver results of the highest quality.

Of the 350 persons employed in Vohenstrauss, around 100 are working in production and development. The company values vocational training and the expertise of its employees very highly, and so also trains many

Dirk Offergeld, Plant Manager Kennametal Vohenstrauss (left), and Walter Grob, NUM, at the official congratulatory function for the operational start of the 100th machine with NUMROTO.

View into a part of the first hall.

Josef Braun and Johann Portner, Kennametal, with the support specialist from NUM, Reinhold Kraus (from left).

apprentices. Approximately 60 apprentices are employed at three Kennametal factories. They all complete their basic training in Vohenstrauss before being assigned to the other factories where their training continues. This way the company ensures that well-trained technical personnel are also able to master any challenging task the future might bring.

Johann Portner, Production Manager of Customised Tools, highlights a further element: "To be able to deliver to our customers as quickly as possible, we access the centrally-stored production data from the machine. This way we can manufacture – very flexibly and purpose-suited – any tool on any machine at any time." Kennametal's customers can count on us to deliver customised tools in the shortest time possible. "If it's urgent, then we will produce tools, including surface coating, in just 5 days with our customer helpline" elaborates Johann Portner and underlines the company's customer orientation.

Dirk Offergeld, Plant Manager at Kennametal Vohenstrauss, puts great value on NUM's excellent support: "In the event of a breakdown, we depend on a solution being found quickly. NUM works both unbureaucratically and flexibly, which helps us enormously and forms the basis for a mutually reliable collaboration." Extensive technical know-how, as well as the combination of producing standard and customised tools and developing new tools, makes the factory a competence centre for carbide tools within the company group. NUM therefore congratulates the team in Vohenstrauss not only on
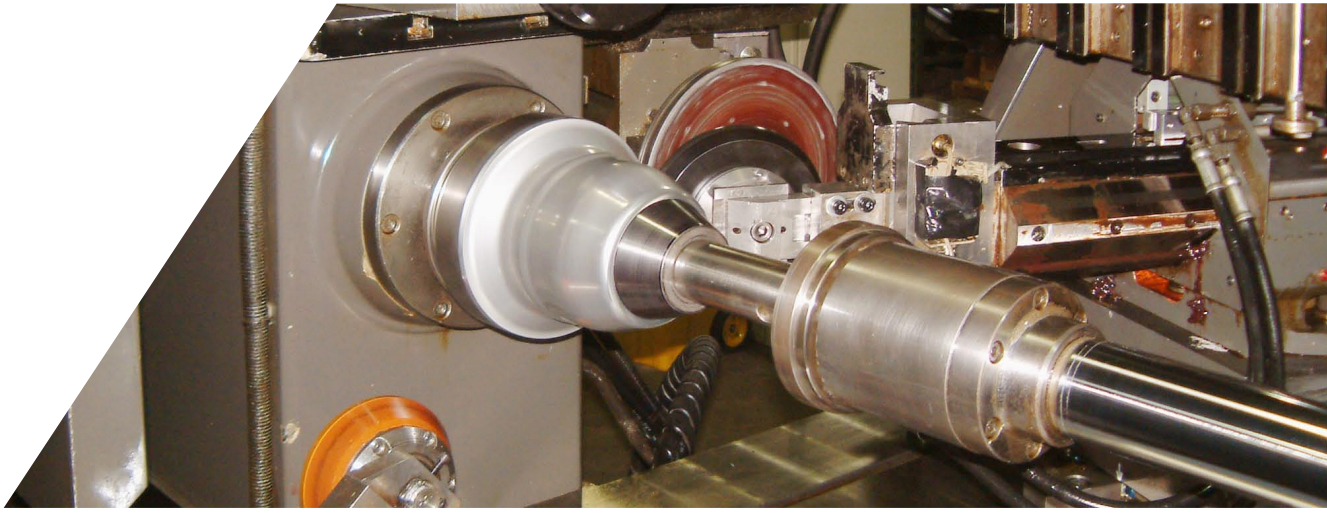
their 100th machine with NUMROTO, but also on this convincing proof of performance.

10 machines in full production operation, being attended by just 2 workers.

NUMspecial Solution for spin-forming machines

Maximising productivity while reducing cost and achieving consistent quality can be approached from different directions. One being to elevate manufacturing flexibility, efficiency and quality through better technology encompassing innovative products and solutions at affordable cost.

With this goal in mind, NUM USA has developed a NUMspecial solution, marketed in the USA under NUMspinform. This cost effective control solution is aimed at a wide variety of spin-forming machines. Configured with a state-of-the-art NUM CNC and user-friendly software, it can be applied to new machines or used to retrofit existing machines of different types and brands. NUMspinform achieves more flexible and efficient use of machines and operators across the production floor.

The concept behind NUMspinform is to provide a straight forward, easy to learn programming / teaching spin-forming method. The core of NUMspinform is a Windows-based graphical operator interface software package. It allows the machine operators to program / teach and operate spin-forming machines without knowledge of ISO code or CAD programming. Although, ISO code or CAD programming can be used, if desired. The system includes features such as: joystick a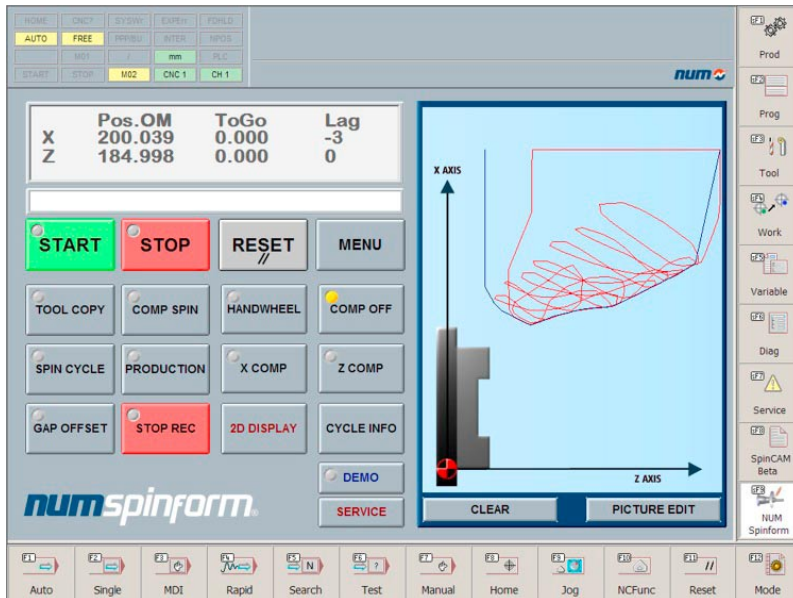nd servo-hydraulic interface, record and playback, 2D safety zone, on-the-fly handwheel correction and offline editing of the safety zone and the spin cycle.

The machine operator is guided and prompted by questions and pictorial information presented on an LCD screen. The data entry screens provide a comprehensive approach that depicts the initial configuration data fields associated with the machine and process setup data. After the data entry session is completed, the operator can proceed to teach / record the tool shape, enter the material thickness of the part, form the first part via a joystick (spin cycle) and make modifications or corrections to the spin cycle via a handwheel or by offline editing. The result is a modular, easily modifiable program, which will produce the desired part or family of parts.

What is metal spinning?

The spin-forming process is achieved by clamping a blank (metal disk) against a tool (chuck) with the machine tailstock, in order to be rotated. A spin roller, on a two-axis slide (X and Z), is programmed / taught to make a series of sweeping motions to progressively shape the blank onto the tool. Other slides and a tool changer can be used to carry out finishing operations such as machining, profiling, trimming, beading, flanging, etc.
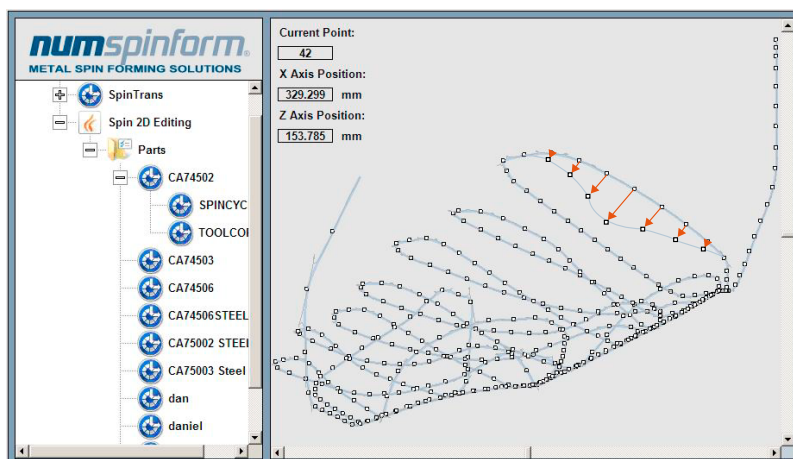
numspecial.

cycle can be modified as many times as desired to obtain the required production program.

4 Offline editing

Program path optimisation can be accomplished, offline, after the operator finishes recording the tool copy (safety zone) and/or the spin cycle. The graphical editing tool allows the operator to graph the recorded tool copy or spin cycle and optimise it by modifying the roller path or the safety

zone in the X or Z axis or by modifying the spline curve of the spin cycle.

NUM's core strategy to provide special solutions brings productivity and innovation to niche markets such as spin-forming.

Software Features:
1 Tool Copy

The operator makes a copy of the shape of the tool (chuck), before the actual programming / teaching starts.

Then, the CNC automatically calculates a 2D Safety Zone to avoid a tool-roller collision. In addition, the operator can set the desired wall thickness – "Gap Offset" – of the part.

2 Spin cycle

Using a set of joysticks the operator can manually spinform the first part while the CNC is recording the axes path. When recording the spin cycle,

the tool and the roller are protected by the 2D Safety Zone. Usually the first sample part is spin-formed at a relative low speed to account for the operator's reaction time. After the spin cycle is recorded, it becomes a pro-

duction program that is stored in the CNC for playback at any time in the future (Record and Playback).
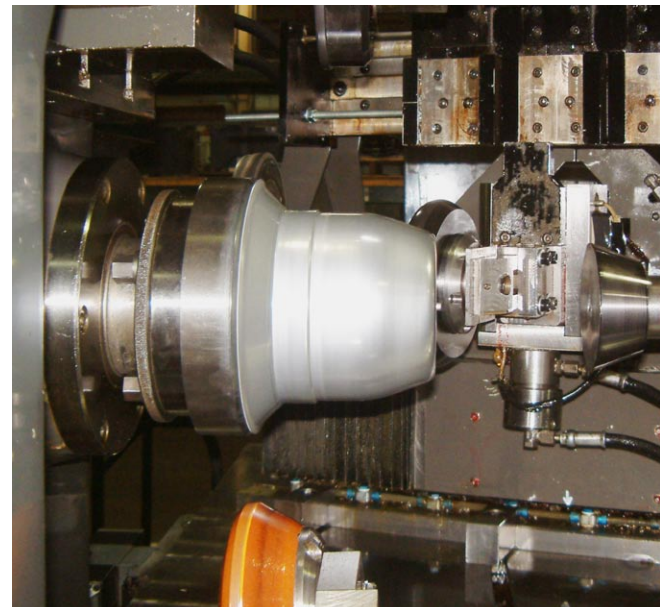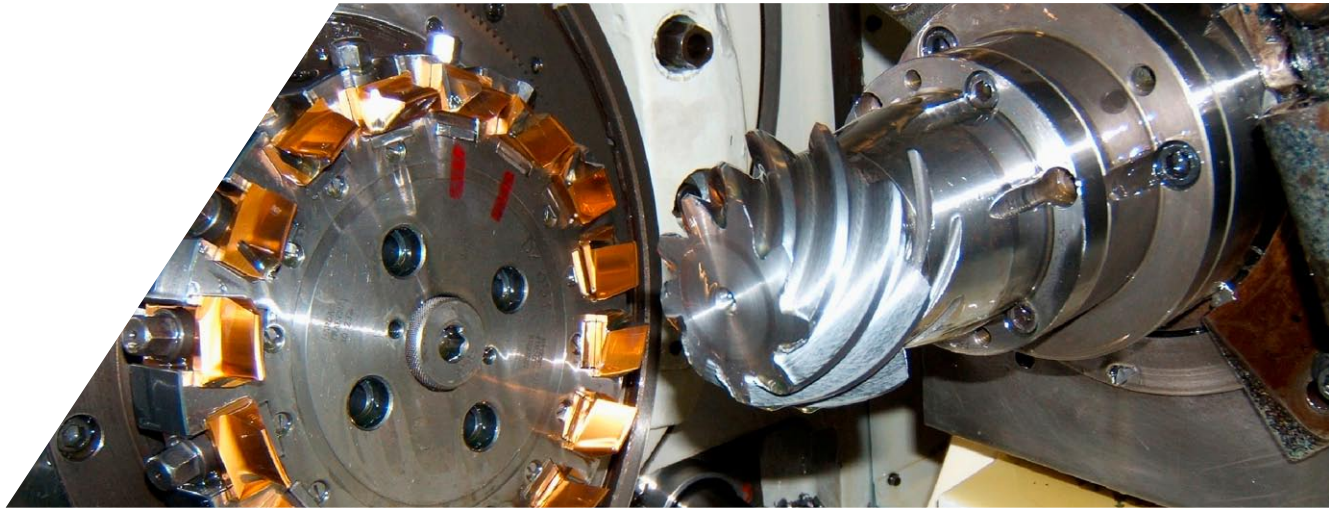
3 Compensation of the Spin Cycle

The spin cycle path can be optimised on the machine, after the operator finishes recording the first cycle. The spin cycle can be optimised by modifying the roller path in the X or Z axis – on the fly – via a handwheel. The spin

Production of spiral bevel gears with a CNC hypoid automatic hobbing machine and NUMgear

Didimo Zanetti, an Italian company located in Casalecchio di Reno, Bolzano province, produces drive elements for backhoe loaders, tractors and haulage vehicles. The company, which was founded in 1952 by Didimo Zanetti, is currently managed by his son, Andrea Zanetti, who serves as managing director. Production is split into two parts: Ninety-five percent consists of parts for differential and speed-change gearboxes for the original equipment and the rest consists of parts, which are intended as replacement parts.

The company has decided to convert the Gleason model 641 mechanical hypoid automatic hobbing machine, which is used for manufacturing spiral bevel gears, sprocket wheels and rims, into an CNC machine.

The primary goal has been to avoid costly tests and inspections of the machine in order to repair mechanical malfunctions due to wear from intensive use of the machine during extensive production uptimes. Such tests must be carried out by qualified personnel, which are increasingly difficult to find. Even an occasional mechanical problem causes considerable difficulties in completing a production lot and complicates the company's production planning.

Lanzi snc di Ozzano Dell'Emilia from the province of Bologna was selected to carry out the machine transformation project. The company founded in 1964 by Francesco Lanzi is currently headed by his son Luigi Lanzi and is engaged in modernising machine tools. Ninety percent of the companies operation is geared for the Italian market.

For this project, NUM has contributed its NUMGear all-in-one solution, based on the Axium Power CNC System. To implement the work cycles, the company cooperated closely with Didimo Zanetti's quality representatives for spiral bevel gears, in order to incorporate their knowledge and experience of many years in spiral bevel gear production.

Another important contribution from NUM to this project has been its support in identifying optimal parameters for control of these special gears. In this respect, the cooperation paid particularly off with Luigi Lanzi, who perfectly re-engineered the machine's electromechanics and was even able to achieve an optimal dynamic balance between the electronics and mechanical components.

The quality of the NUM servo drives, the interpolation of the traverse path

numgear

via the NUM Axium Power CNC, and the simple programming, for example, with macro commands, have also led to the machine's higher flexibility during the adjustment phase.

Due to the introduction of the Helical Motion Technique, the cutting phase for the bevel wheel has been improved. The simultaneous interpolation of the holding device's axes for the workpiece and of the sliding carriage was not possible with the previous machine.

Production was started in early December 2007 and approximately 30,000 bevel wheels were produced within one month despite the holiday season. No problems arose which would have required production to stop. The retrofit has led to a reduc-

tion in production time of about 15% and an improvement in the quality of the parts manufactured.

The success resulting from consistently pursuing the original project goals and the subsequent improvement of the production parameters, has led the management of Didimo Zanetti to commission a new project to retrofit the production units from the plant located in Casalecchio di Reno.

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