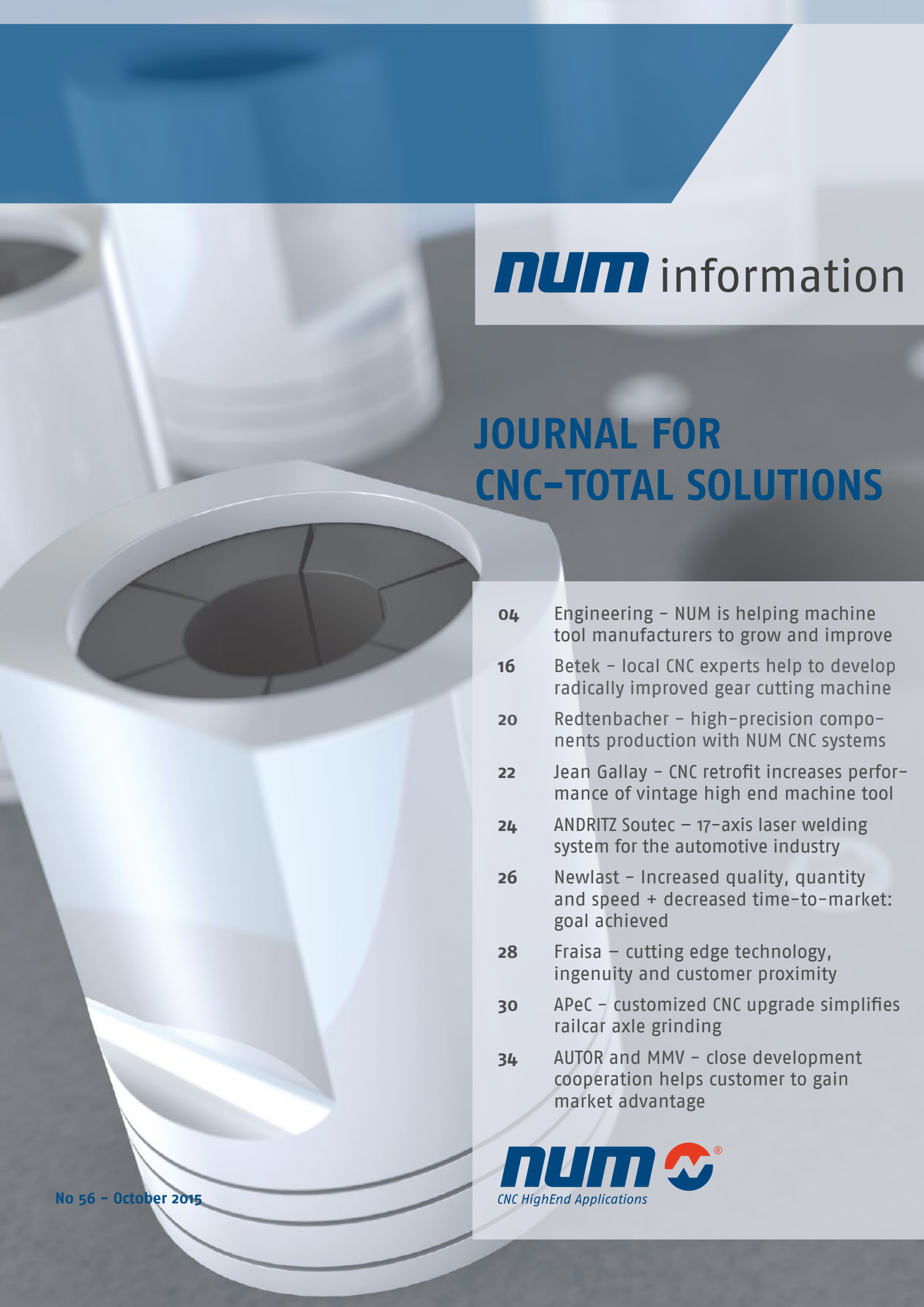

num information

JOURNAL FOR CNC-TOTAL SOLUTIONS

num®
CNC HighEnd Applications

No 56 – October 2015

Editorial

Peter von Rüti, CEO NUM Group

Dear Readers

It is our declared aim, through our engineering, our products and our complete solutions, to give you and your company a competitive advantage in an ever more demanding market. As you can read in this edition of NUMinformation, we have succeeded across a range of projects in significantly optimizing machine productivity through targeted engineering work and close collaboration with machine manufacturers and even, in some cases, end customers. In addition to this increase in productivity, we have also improved the quality of the manufactured components. The foundations for this success are, firstly, open and flexible products and, secondly, more than 50 years of experience in machine automation. In order to implement special features in terms of software, it is of course necessary to have full access to the systems. As NUM develops its core products itself, such as CNC systems, drive amplifiers and motors, we are in the position to ensure that this systems access is appropriately designed. Present at all our branches, our application development teams are thus able to develop these special features locally together with the machine manufacturer. Should you wish, you, as a machine manufacturer or user, can also develop your own special features and functions. We will then be on hand to provide training and advice. It also makes sense, of course, to give some thought to how you can protect yourself against counterfeit copies and intellectual property theft. I believe it important to mention that NUM is able to integrate customers' special functions into the operating system of the controller encrypted in such a way that prevents use by anyone other than users defined by the customer.

NUM has more than 45 years of experience in motor development and production. Today, machine manufacturers can choose from over 5000 different servo motor models and more than 2000 synchronous and asynchronous spindle motors. Development continues apace in this area too: besides our existing single-cable motors, at this year's EMO we will also be announcing a version with a high-resolution encoder. Further details can be found in this newsletter.

"It is our declared aim, through our engineering, our products and our complete solutions, to give you and your company a competitive advantage in an ever more demanding market."

(Peter von Rüti, CEO NUM Group)

Our industry solutions encompass a wide range of applications. We will be at your side as a partner to help adapt these solutions to your own specific requirements. Our common goal is to be successful in rapidly changing markets. Together, we are stronger!

I hope you enjoy reading NUMinformation and hope to see you in person at one of the many trade fairs NUM will be attending.

Peter von Rüti
CEO NUM Group

Imprint

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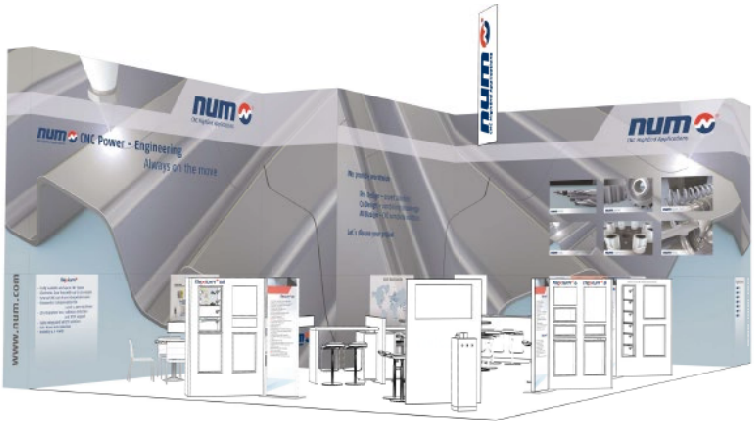
NUM Creative Powerhouse looks to the Future

The enclosed cube serves as an invitation to NUM's booth at EMO 2015 in Milan. Fold the cube and bring it with you when you visit the exhibition. Our booth is F10 in Hall 3. You will be able to preview some of the exciting developments that are taking place in NUM's Creative Powerhouse – and maybe gain a glimpse of where the future might take us.

Our research and development department, which is also always very involved in collaborating with customers, takes your requests and ideas very seriously and strives to implement them in the near future. One of the current topics is machine monitoring using 'Augmented Reality' and 'Glyph Recognition'. The cube in front of you is equipped with such glyphs. It allows you to control the rotation and zoom functions of a webcam to obtain detailed images of remote machinery or workpieces. This can be a very expedient tool in meetings or when solving a problem, because the subject can be viewed from all angles and perspectives.



NUM Event Calendar 2015 / 2016

EMO 2015
October 5–10, in Milan, Italy
Booth F10, hall 3

sps ipc drives 2015
November 24–26, in Nuremberg, Germany
Booth 271, hall 3

GrindTec 2016
March 16–19, in Augsburg, Germany

Industrie 2016
April 4–8, in Paris, France

CCMT 2016
April 11–15, in Shanghai, China

Events

NUM is helping small- and medium-sized CNC machine manufacturers to grow

After a slowdown in 2012, the machine tool industry has resumed its growth and continues to be the largest sector of the global motion control market. The Chinese government can probably take some of the credit for this climb-back. China continues to be the world's largest producer and user of CNC machines, with its government's latest Five-Year Plan specifically calling for increased take-up of high-end computer numerical control (CNC) equipment by indigenous CNC machine manufacturers. The global market for machine tool CNC equipment is dominated by a relatively small number of very large manufacturers, who together account for about 75% market share. The remaining 25% of the market is served by small to medium sized niche players, and this is the sector in which CNC vendor NUM chooses to operate.

A history of CNC firsts

NUM is no newcomer to CNC. It began developing a numerical controller back in 1961, when it was part of Telemecanique (now Schneider Electric). This product was launched in 1964 and was one of the first and most technologically advanced machine controllers on the market. NUM was spun out in 1978 and quickly established a reputation for innovative engineering. Highlights include the world's first 16-bit CNC controller in 1983 and the industry's first servo drive featuring digital current control in 1991. However, it wasn't just hardware that benefited from this resourcefulness. In 1986, the company introduced the rotation around tool centre point (RTCP) machine control function to the CNC software world, followed quickly by the groundbreaking NUMROTO tool grinding software. Today, this software is ubiquitous – it is used by many of the world's leading machine tool manufacturers and it is often cited by users as a key product choice differentiator.

NUM moved its headquarters from Paris to Teufen in Switzerland in 2006, following a management and investor buyout, and is now a wholly independent company. It has continued to grow steadily and nowadays operates R&D facilities in France and Italy, as well as in Switzerland, and employs around 280 people. NUM currently has sales and technical support centres around the world. Eleven of these support sites, including two in China – one in Beijing, the other in Changzhou – are NUM Technology Centers, which undertake development of application- and customer-specific CNC hardware and software in their own right.

This decentralized approach to customer support is a main element of NUM's overall business strategy, enabling highly focused teams of locally placed experts to resolve CNC design and implementation issues very quickly and efficiently. To a large extent, the ability to deploy this highly responsive sales and service structure is due to fundamental design and development decisions taken in Switzerland. All NUM systems are based on an open architecture, fully scalable CNC platform. This enables local engineering support staff to create bespoke control systems for customers, regardless of the size and complexity of machines. It also simplifies the procurement and integration of any necessary third party hardware and software. By positively encouraging close collaboration between customers and its engineering support personnel, NUM believes that it gains a much better understanding of machine control requirements, enabling it to deliver CNC systems that consistently surpass customers' expectations. Hence the company's motto – NUM CNC solutions provide machine builders with a competitive advantage.

Engineering excellence

Unlike many of its competitors, NUM designs, develops and manufactures all of the core products in its CNC systems – including the drives and motors – as part of its strategy to maximize quality and overall performance. Most of these products are produced at the company's main manufacturing plant in Cuggiono, Italy. The motor production section has over 45 years' experience of producing innovative designs based on conventional and concentrated winding techniques, optimized mechanics and proprietary magnets. During this time, it has created more than 5000 different types of servomotors and over 2000 different types of synchronous and asynchronous spindle motors.

This extensive background in motor engineering – which includes specialist expertise in high speed flux-weakened synchronous designs – enables NUM to provide customers with fast turnaround motor customization services, as well as state-of-the-art standard products. NUM's latest brushless AC servomotors, for example, cover a torque range of 0.5 to 150 Nm and speeds from 1500 to 8000 RPM, with a wide choice of inertia values to suit different machine kinematics. The range includes innovative single cable models, which help to reduce machine build costs and improve reliability by eliminating the need for separate encoder feedback cables in the motor's power cable.

World-class CNC

NUM's latest-generation Flexium+ CNC platform offers a choice of three CNC kernels, allowing designers to employ the most cost-effective and technically appropriate form of control for a diverse range of machine tool applications. This ability to use the same CNC architecture across multiple different machines provides small to medium sized machine tool builders with an enormous advantage, by allowing them to make most efficient use of what are often very limited design resources.

The smallest CNC kernel, the Flexium+ 6, can control up to four interpolated axes and a spindle, whereas the largest Flexium+ 68 CNC kernel can control up to 32 connected devices, any of which can be interpolated axes or spindles. And of course, any Flexium+ CNC system can contain multiple CNC kernels, interconnected via real-time Ethernet and controlled by a single automation PLC, facilitating control of large multi-cell manufacturing equipment with over 200 interpolating axes and spindles.

The Flexium+ platform includes a fully integrated safety architecture, known as NUMSafe, that scales with the system. This enables designers to implement rigorous machine safety schemes using very few additional components. All critical system operations are overseen by a safety PLC module that operates in conjunction with safe I/O modules and safe motion monitoring circuitry that is built into NUMDrive X servodrives. NUMSafe requires minimal extra wiring and uses a Fail Safe over EtherCAT (FSoE) protocol to ensure integrity of all safety-related data. The architecture complies with the EN ISO 13849-1 machinery safety standard up to PLe, and with the EN 61800-5-2 functional safety standard for variable speed drives, up to SIL 3.

NUMDrive X servodrives are some of the smallest, highest power density units on the market. Designed specifically for use with the Flexium+ CNC system, they use advanced DSP control techniques to maximize the CNC kernel-to-drive servo bus speed, and feature high loop bandwidths and special acceleration algorithms for uncompromised speed and positioning accuracy. A numerical processor in the CNC kernel, together with the precision number-handling capabilities of Flexium+ software, helps to ensure a high overall CNC resolution and facilitates 'sub nano' interpolation between axes. There are numerous configuration options to allow designers to minimize machine build costs through use of axis-appropriate technology.

The Flexium+ platform is backed by powerful software. All CNC, servo drive, I/O, automation PLC and safety PLC functions are programmed using a single unified toolset. A fully customizable human-machine interface (HMI) allows users to add value to their machines, through improved ergonomics and touch-sensitive controls. NUM's application support software covers a broad range of machining functions such as grinding, tool grinding, turning, milling, gear hobbing, shaping and finishing, as well as waterjet, laser and plasma cutting.

Small and medium sized machine tool manufacturers need look no further than NUM for all their CNC needs. They will discover a powerful ally in their quest to succeed in this fast-evolving market.

Engineering

Flexium+

Axis sharing and machine safety

Sharing axes between different NCKs

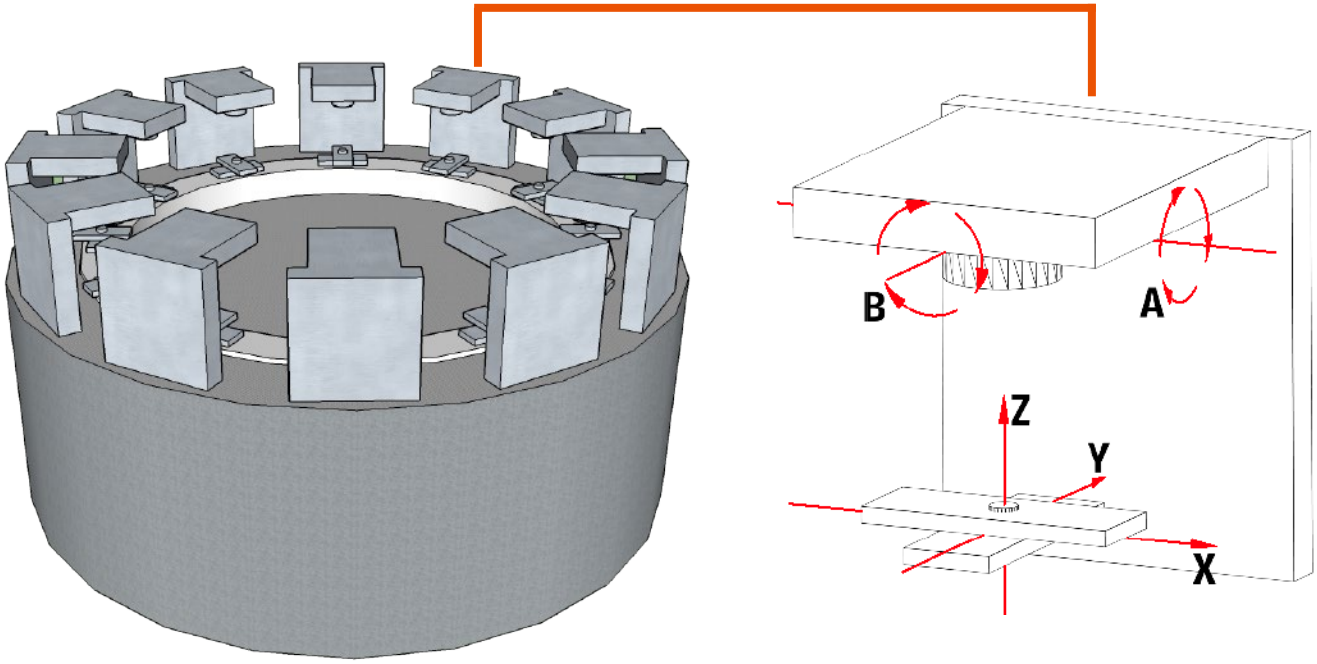
Just one year ago in NUMinformation No 55 we were underlining the benefits and functionality provided by the new Flexium+ 68. We are now announcing another important evolutionary step which further extends system flexibility.

The Flexium+ 68 architecture provides a modular and very flexible means of satisfying complex control requirements, offering up to 32 axes or spindles per NCK, more than 200 axes per system, integrated functional safety, etc.

To address the need of complex machines, it is now possible to physically connect all 'shared' digital servo drives to the first NCK. In terms of machine logic functionality, the channel of another NCK can take the control of such 'shared' axes, which can interpolate with the same speed and precision as a local axis. This sharing/moving of axes can facilitate the design of very specialized and efficient machining units.

To take a concrete example (see picture), this transfer machine has a main rotary table with 12 stations, each comprising a dual-axis head (B and C axes). These dual-axis heads are shared with up to three machining units per station. This means that in total, there are 36 machining units, working on 12 different stations, and that each working unit can interpolate with the dual-axis head of the stations in continuous 5-axis mode. The CNC system architecture consequently has 12 channels, each of which has three local axes, plus two shared axes, plus the possibility of up to 'n' spindles.

Transfer machines are just one example. This new function introduces the possibility of having no bounds on the number of axes that can be shared between channels, for any kind of complex machine. Creative machine designers now enjoy unlimited freedom of expression!



Safety of machinery

The "Machinery Directive 2006/42/EC" became applicable on 29 December 2009. Its aim is the harmonization of health and safety requirements applicable to machinery, as well as the guaranteed free movement of goods for new machinery within the EU market.

To facilitate technical progress, the Machinery Directive 2006/42/EC defines only basic requirements which new machines have to comply with when being placed on the market. These are complemented by a number of more specific requirements for certain categories of machinery. At the same time, the Directive dispenses with the concrete specification of technical solutions that must be adopted by the manufacturers. To allow manufacturers to prove compliance with these basic requirements or the presumption of conformity more easily and in order for this evidence to be checked, harmonized standards are to be applied. These were written in accordance with a mandate established by a European Commission concerning the prevention of risks that may arise from the design and construction of machinery.

The Machinery Directive 2006/42/EC clearly states that a machine cannot be placed on the EU market unless it has been subjected to a risk assessment by the manufacturer or their authorized representative.

The safety requirements for the design and construction of the control, which were created to aid the safe and trouble-free operation of the machine, are also key factors behind ensuring the safety of the entire machine at any time.

NUM offers a wide range of scalable safety components and other necessary means with approved safety features required by machine manufacturers or their authorized representatives in order to prove and guarantee that the machine's safety functions comply with the basic health and safety requirements of EN ISO 13849-1 (PLe) and EN IEC 62061 (SIL). These standards are directly linked to the Machinery Directive 2006/42/EC.

In order not to affect the reliability of the safety functions during integration, the Flexium+ control system" contains safety components through which safety functions up to Category 4 PLe and SIL 3 can be set up for each respective path of the control.

Naturally, the integration of a control system such as Flexium+ should only be carried out by highly qualified personnel observing the correct integration measures and the final qualification process.

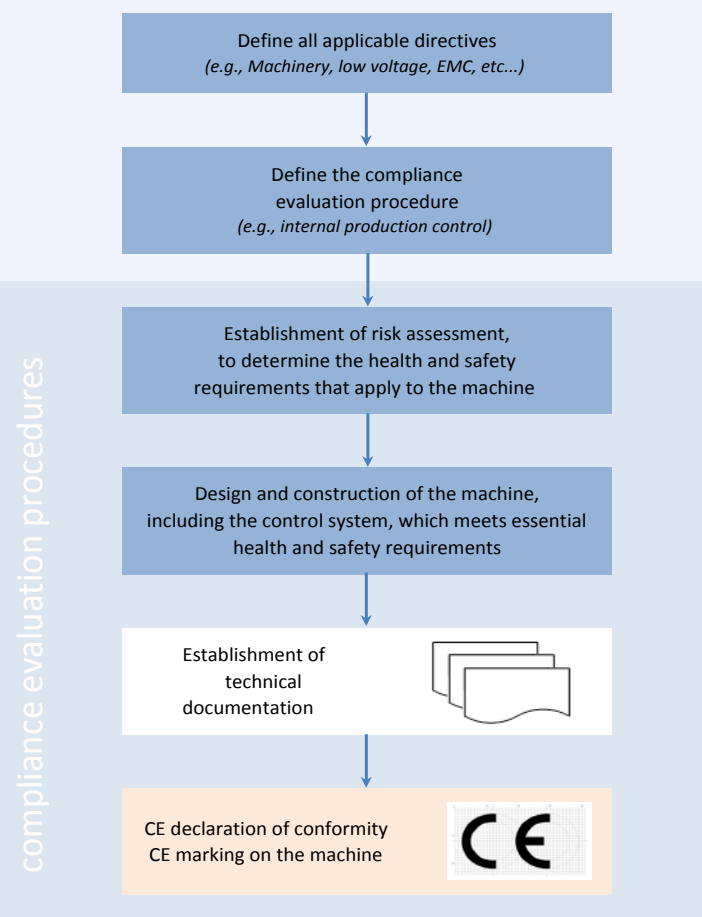
Looking at the whole machine, the various responsibilities regarding safety can be summarized as follows:

- Supplier of safety components: Guaranteeing the components' conformity with the EN IEC 62061 and/or EN ISO 13849 standards.

- Supplier of the construction and programming of the safety controller: Guaranteeing the safety functions and their performance in accordance with the EN IEC 62061 and/or EN ISO 13849 standards, and with the required level of risk analysis.

- Manufacturer of the machine (or their representative): Guaranteeing the machine's conformity with the basic health and safety requirements of the "Machinery Directive". In order to issue a declaration of conformity and affix the CE marking on a machine, the manufacturer or their authorized representative is required to carry out a risk analysis of the machine. If residual risks cannot be completely ruled out, the manufacturer has to explicitly inform the user of this in the operating instructions.

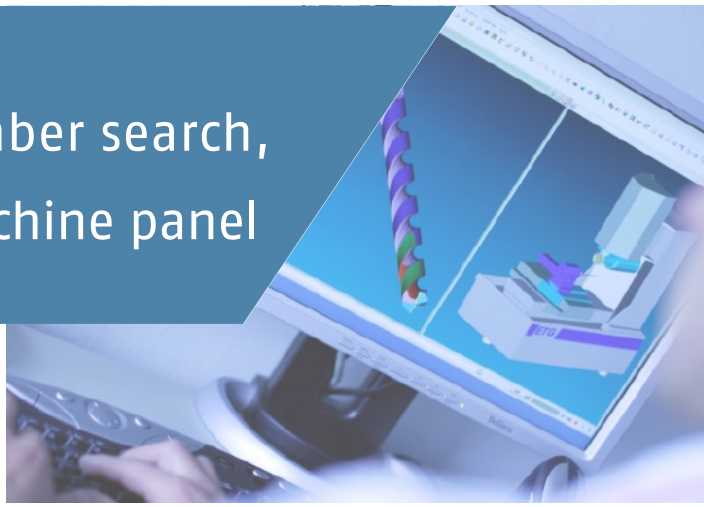
- The employer (user): Implementing measures that ensure the machines' conformity is maintained and the safety and training of personnel are guaranteed.



This flow diagram shows the basic procedure that must be followed in order to be allowed to apply the CE mark to a machine to indicate safety compliance.

Engineering

Flexium+ graphical sequence number search, machine parameters and MP06 machine panel



num
CNC HighEnd Applications

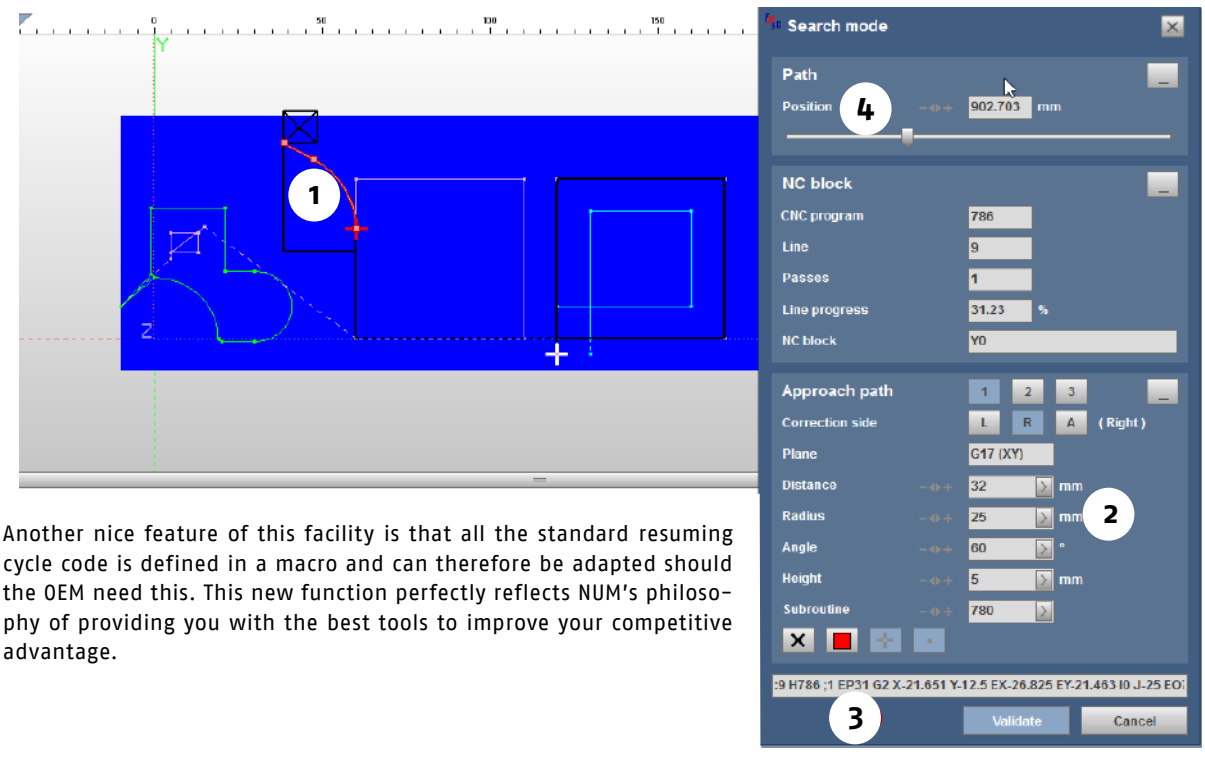
Graphical sequence number search

Let's describe it with an example. Imagine a part program block whose execution takes several minutes, for example in flame cutting, and that an incident occurs towards the end of this block. Resuming at the start point will result in loss of time and difficulty in handling the flame. Flexium 3D will help us. The operator just needs to use Flexium 3D to select the location of the incident. The block where the problem occurred will be identified automatically, and the percentage of execution of this block will be shown. But there is still a choice to be made: how do we best reach the resumption point? Flexium 3D will help to define this trajectory using just a couple of clicks. The operator only needs to position the axes on the safe side and then press start. All actions will be linked automatically – but under full control of the operator – until the machining process is fully restarted.

- Select SEARCH mode in Flexium 3D.
- Click on the location where you want to resume the process (1).
- Use the default approach path or define a new one (2).

- A full approach sequence (in white) consists of the optional following elements:
    - A call to a subroutine (e.g. for drilling before restart).
    - A plunge.
    - A straight line followed by an arc of a circle tangential to the trajectory (left or right).

- (3) shows, for information, the search sequence sent to the NC.
- (4) Shows the distance already machined. The cursor allows for shifting the resume point.



Another nice feature of this facility is that all the standard resuming cycle code is defined in a macro and can therefore be adapted should the OEM need this. This new function perfectly reflects NUM's philosophy of providing you with the best tools to improve your competitive advantage.

On-site editing of machine parameters

The growing complexity of machines makes it more and more difficult to handle commissioning directly at the operator's panel. Generally a project encompasses everything from machine parameters to the PLC program, custom macros and other files.

During a service call it is not always possible to have access to the full project for various reasons, ranging from confidentiality to technician specialization. One might however want to make a small change, such as temporarily inhibiting an axis or adjusting an offset after mechanical intervention. The solution is at hand thanks to a dedicated page in the Flexium HMI. This page, which is password protected, initially provides access to a limited set of parameters (Drives and NC) that are part of first level maintenance. However, it also offers access – again password protected – to a second level of control in which all the parameters can be adjusted. The service technician can then easily adjust the required data to complete his or her mission and have the machine restarted. The new parameters will remain operational as long as necessary.

But what happens if there is a consecutive intervention involving the full project (e.g. an upgrade of the machine)? Will the original project not override the previous changes and therefore lead to unwanted behavior? This situation is fully under control. During this second intervention, while logged in to the machine, Flexium tools will detect that some changes were made in respect to the original project. Such changes are clearly identified and current and initial values are displayed. The technician will simply need to confirm what changes to keep and what changes to discard. All of this will be clearly identified.

New EtherCAT machine panel – MP06

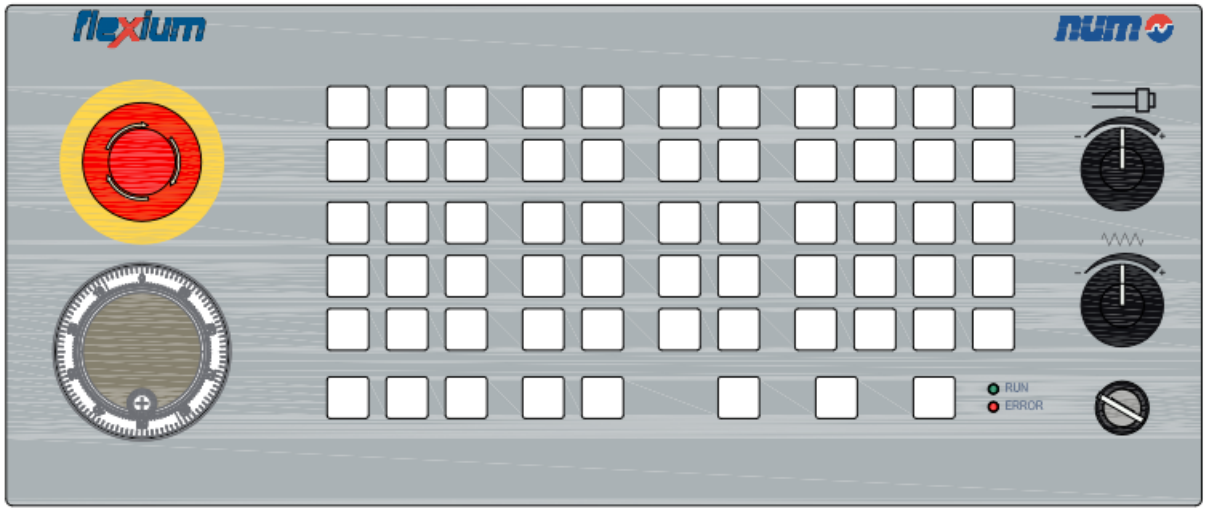
The machine panel range is further extended with the introduction of the new MP06. This can be easily connected to Flexium+ (or Flexium) through EtherCAT, and integrated within the PLC project by using Flexium Tools and a dedicated library.

Compared to its predecessor, the MP06 machine panel has a number of advantages:

- The keys actuate real mechanical switches (no membrane keys) for better tactile feedback and reliability.
- The IPC no longer needs a CAN interface; connection is achieved by means of the Ethernet port.
- Customization of the keys is now easier; there is no longer any need to print and insert plastic foils from the rear of the machine panel. With MP06, each key can be simply customized either by inserting an icon (in each key that can be opened) or by laser printing the keys' cups.
- As an option, the axes and spindle overrides can be implemented by using encoders with 47 coded positions; each position provides tactile feedback in the form of a mechanical 'click'.

MP06 is available with the following options:

- Handwheel
- Absolute encoders for the override (standard is potentiometers).

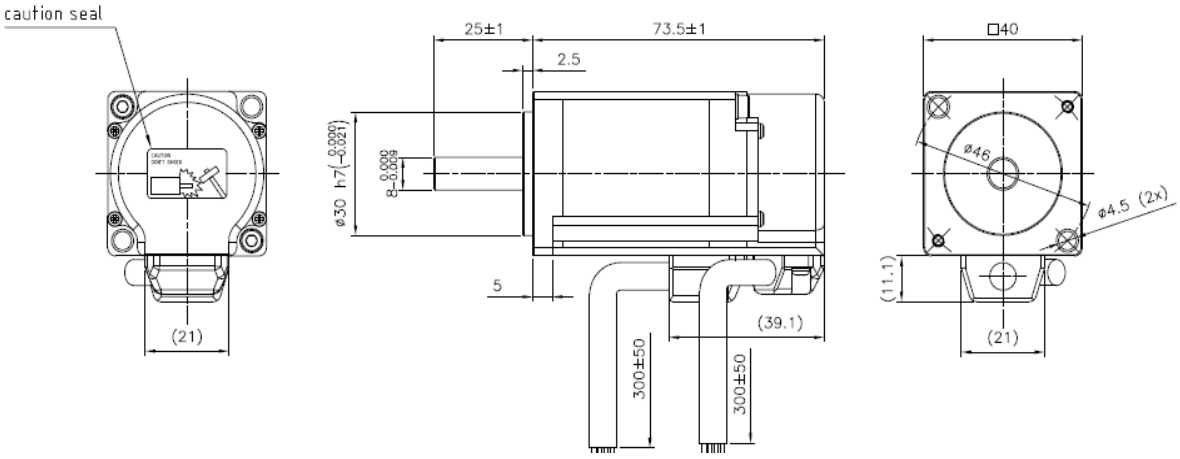


Engineering

Flexium+ MDLUX007 and BHX040, MDLL3005 power supplies and single cable motors

MDLUX007 and BHX040

We have added a new drive and motor to our product portfolio, intended for small machine tool applications such as driving small swivel heads. The new BHX040 motor has a 40 mm frame size and produces 0.318 Nm continuous torque. Unlike most small motors, the BHX040 can be supplied with 400 Vac, and can therefore be controlled by a standard NUM servo drive connected to a standard 3-phase industrial mains supply. The integrated encoder has a resolution of 17 bits per revolution, this also enables 65,536 revolutions (multi-turn) to be coded.



In order to optimize the regulation characteristics when using the BHX040 motor, we have added a new 7A drive to our MDLUX range. Known as the MDLUX007, the drive is available with the following options:

- Single-axis or Dual-axis module
- Standard or High Performance
- Safe Torque Off module (NUM-STOX)
- Safety module NUM-SAMX with STO, SLS, SOS, SS1, SS2, SLP, SDM safety functions.

MDLL3005 power supplies

There are some applications where a typical industrial (3-phase 400-480 Vrms) mains supply cannot be used. For example, if the motors are not suitable for such a voltage, the end user's mains is single-phase 230 Vrms, or the standard insulation rules cannot be applied because the machine is in a vacuum. To provide a solution for these applications, NUM has introduced a 5 kW power supply (MDLL3005) which is compatible with single-phase 230 Vrms mains supplies. The principle and the architecture of the system remain the same – the MDLL3005 is an AC/DC converter and is connected to a lineup of standard MDLUX drives.

VEComp: software-enhanced precision!

VEComp is a Flexium+ software function which stands for Volumetric Error Compensation. It enhances machine tool volumetric accuracy and work piece precision. The purpose of the function is to minimize the spatial error of the tool center position at any arbitrary point in the work space. A volumetric positioning error is a deviation in a spatial direction – not necessarily in the direction of the axis motion. The VEComp function is based on a rigid body kinematic model. For each machine having a serial kinematic structure, the error model is originally designed as a superposition of error motions of linear or rotary mechanical components, starting from the workpiece side to the cutting tool center.

The geometric errors, compensated by VEComp, follow the same terminology that is used in the ISO 230-1 and TR 16907 standards, and are described as follows:

- Each linear axis has six error motions (linear positioning error, vertical and horizontal straightness error motions, and three angular error motions – roll, pitch and yaw). Straightness deviations have a direct influence on machine path accuracy and a small angular error can cause a significant effect at the tool center point (Figure 1).
- Each rotary axis motion can also be affected by six error motions: a radial error motion, two radial deviations, an angular positioning deviation and two tilt angular error motions, known as wobble effect (Figure 2). Each error motion depends on the current position of the axis motion.
- The position and orientation errors between axes of linear motion (Figure 3). Two type of errors are considered: parallelism error related to linear and rotary axes of motion, and squareness error related to linear or rotary axes of motion.
- Location and orientation errors of rotation axis. The rotational axes are represented by their axis average lines that are defined by five parameters: two position error coordinates, two tilt angles and a zero position error with respect to a reference frame Xa, Ya, Za (Figure 4).

The VEComp system is a real time application based on kinematic error modeling. It supports more than 40 different kinematic types (3 axis, 4 axis and 5 axis machines – even with gantry axes) and different machining technologies such as turning, milling, grinding, etc. The typical compensation process is as follows:

- A measurement session is needed to identify the magnitude of error sources (six error motions per axis + squareness errors between axes, etc). This uses precision instruments such as an interferometer laser, a laser tracer, laser levels, or 1D or 2D dimensional calibrated artefacts.
- An identification of geometric deviations, in conformity with the ISO standard, needs to be performed. The identified errors are then collected in symbolic variable files and imported by a macro file into the Flexium+ machine controller, and directly used to compensate for systematic errors.

Does this mean that OEMs can now get away with building less accurate machines? No, it most certainly does not! VEComp enables machine precision to be improved by means of software, but the best results can only be achieved if the machine quality is high (no backlash issues, low dynamic deformation, high stiffness, high thermal stability, etc). The highest improvements in precision will be gained on 'big' machines, where due to geometry, small local deviations generate high inaccuracies in the working volumes.

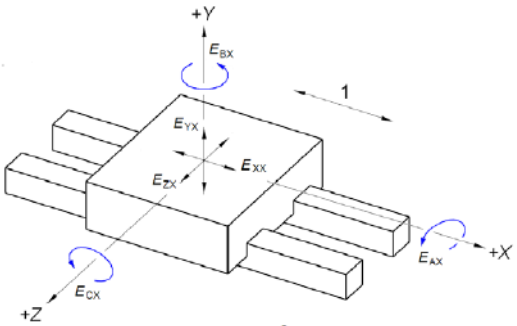


Figure 1

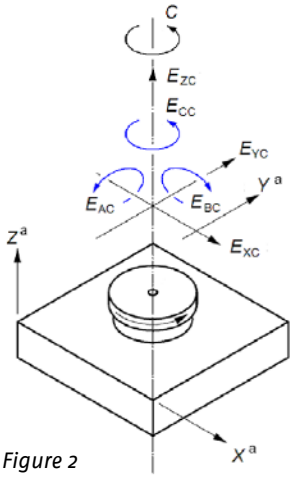


Figure 2

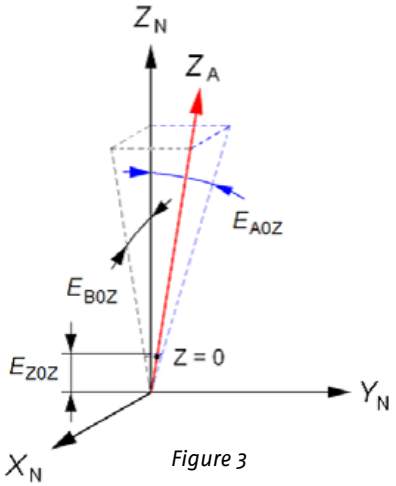


Figure 3

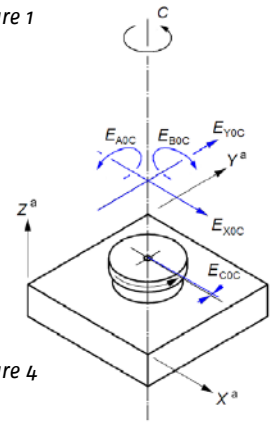


Figure 4

Engineering

Flexium+

Single cable motors and Industry 4.0 solutions

CNC HighEnd Applications

Single cable motors with high resolution encoders

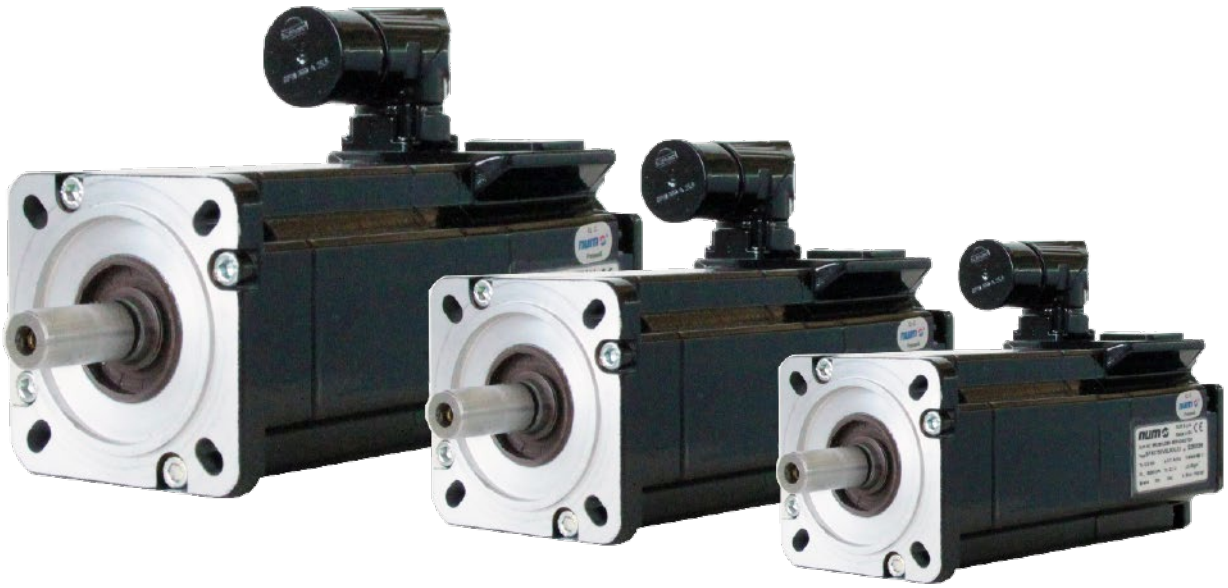
With the introduction of the SHX and SPX single cable servomotors, NUM brought about a revolution in machine tool wiring. By eliminating the need for a separate encoder cable, machine builders can reduce cabling, speed up installation/commissioning, and improve system performance. NUM estimates that for a typical high-end CNC machine installation involving 20-meter cable lengths, the new technology can reduce total motor cabling costs by as much as 20% per axis. Until now, SHX and SPX servomotors were equipped with medium resolution encoders, with the following characteristics and options:

- Absolute position: single or multi turn
- Resolution per revolution: 20-bit (1,048,576 positions per turn)
- Accuracy: plus/minus 60 arcseconds

Today, NUM announces the extension of the SHX and SPX single cable servomotor range by introducing a new high resolution encoder with the following characteristics and options:

- Absolute position: single or multi turn
- Resolution per revolution: 23-bit (8,388,608 positions per turn)
- Accuracy: plus/minus 45 arcseconds

The higher resolution encoder provides better regulation performance, resulting in wider bandwidth, higher stiffness, higher dynamics and better system stability. Machines therefore become faster, more precise and run smoother – while retaining all the benefits of a single cable connection.



With NUMconnect Industry 4.0 ready

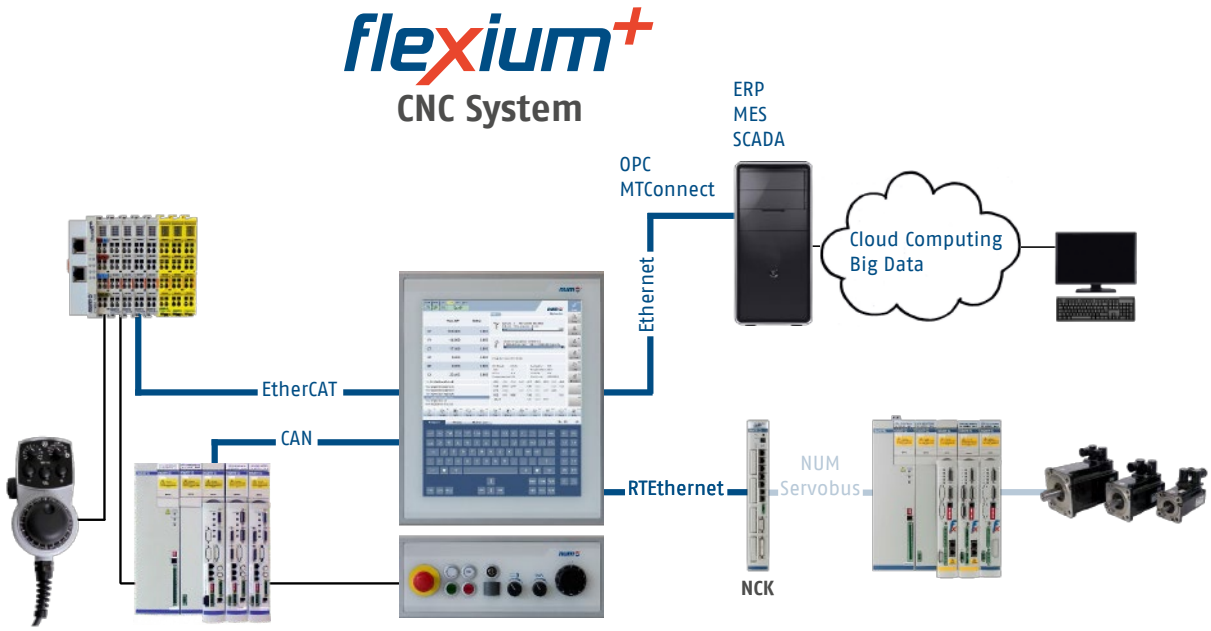
Industry 4.0 was designed to advance the creation and use of information in manufacturing technology. It strives to establish the "Smart Factory", which is characterized by flexibility, resource efficiency and ergonomic design. It also strives to integrate customers and business partners into business and value-added processes. The technological basis consists of systems with IT and software components as well as mechanical and electronic parts and the "Internet of Things" (IoT). Control technologies already offer many paths to contribute to the success of Industry 4.0, and more solutions are continually developing for the future. NUM control systems have always been characterized by their openness and communication capabilities. These features have been further developed from one generation to the next. The current CNC control system Flexium+ is computer-based and includes various field buses, which are basic requirements for a Smart Factory. NUM control systems also feature the OPC and MTConnect interfaces, which are now combined under the term NUMconnect. This meets the criteria for vertical and horizontal integration as required by Industry 4.0.

Openness
A standout feature of NUM control systems is their focus on open design principles. This provides users with an open control platform that has easy access to large amounts of detailed machine data. The goal of Industry 4.0 is to allow resources to be used more efficiently and processes to be improved by utilizing data. NUM's control systems offer a large array of process data out of the box that can be utilized to increase machine efficiency, perform preventive maintenance, and serve high-level monitoring systems. An even greater amount of data can be accessed using NUM's API, which allows users to record customized machine data in real-time from the NC kernel, PLC logic, or the servo drive amplifiers.

Computer-based
NUM control systems are computer-based and therefore are a perfect bridge between the machine tool and the greater Smart Factory. The NUM control system can serve as one platform that integrates both process data gathering and Smart Factory communication. NUM's computer-based systems' intrinsic web technology allows many Industry 4.0 requirements to be satisfied, including remote diagnostics and communication with the machine over the Internet. Thus the NUM control system is a part of the Internet of Things. NUM computer-based systems also allow easy expansion of Industry 4.0 capabilities in the future.

Communication
One of the basic requirements of Industry 4.0 is the ability for devices to communicate within the machine, but in particular to also communicate externally to supervisors and executive management. NUM control systems offer various field buses for this purpose, e.g. EtherCAT or CAN. Typically, they are used to communicate horizontally. The control system can communicate vertically with SCADA, MES and ERP systems via OPC, MTConnect, and other communication interfaces. With NUM's API (ie. FXServer, FXLib, FXLog) as the basis, these can be realized easily and comprehensively. The NUM control systems' communication capabilities are bundled under the term NUMconnect.

Summary
Industry 4.0 is set to become a reality in the coming years. NUM already offers technologies and solutions with which to realize the machines and systems of tomorrow, making it "Industry 4.0" and "Smart Factories" ready.



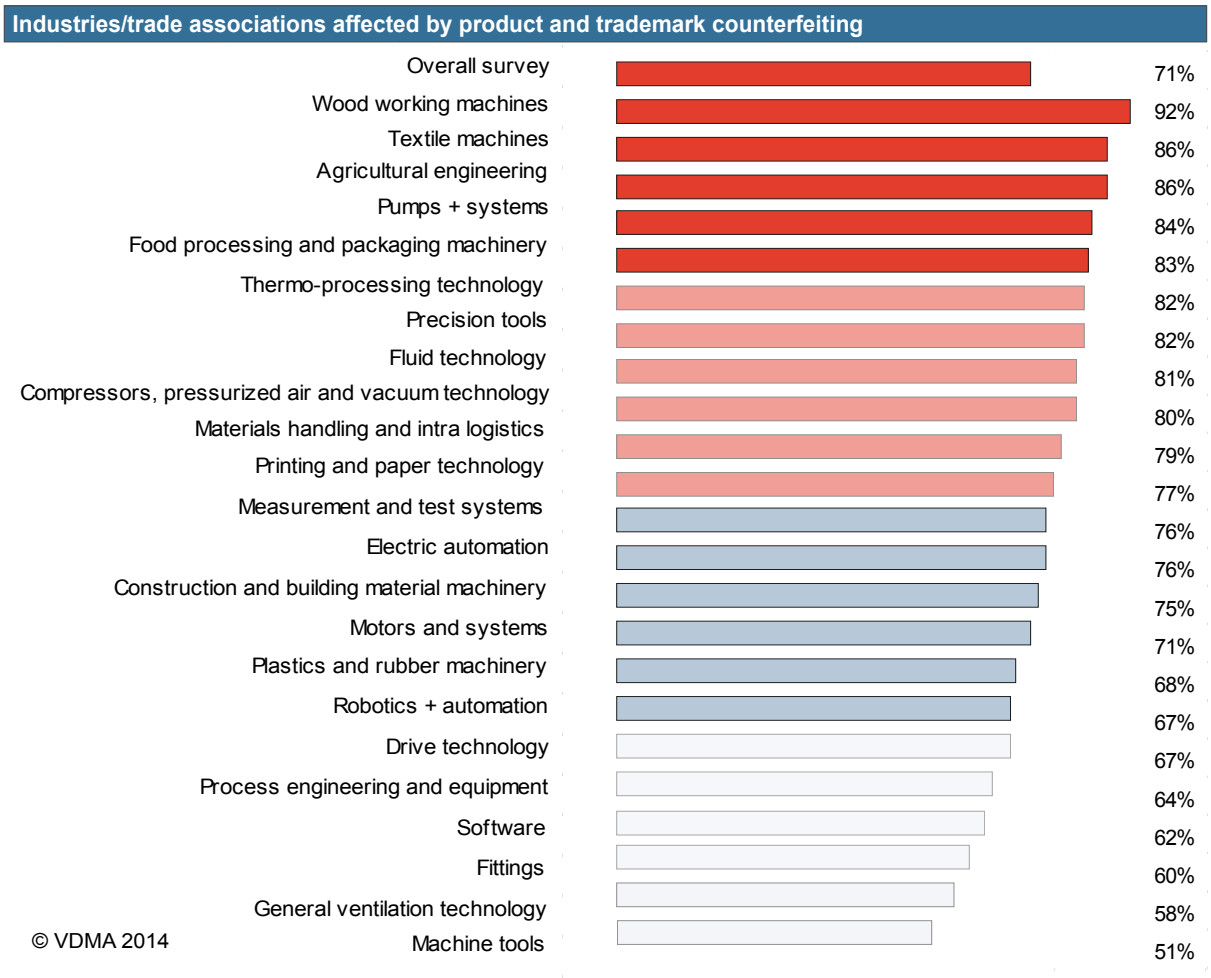
Engineering

Flexium+
Anti-Counterfeiting

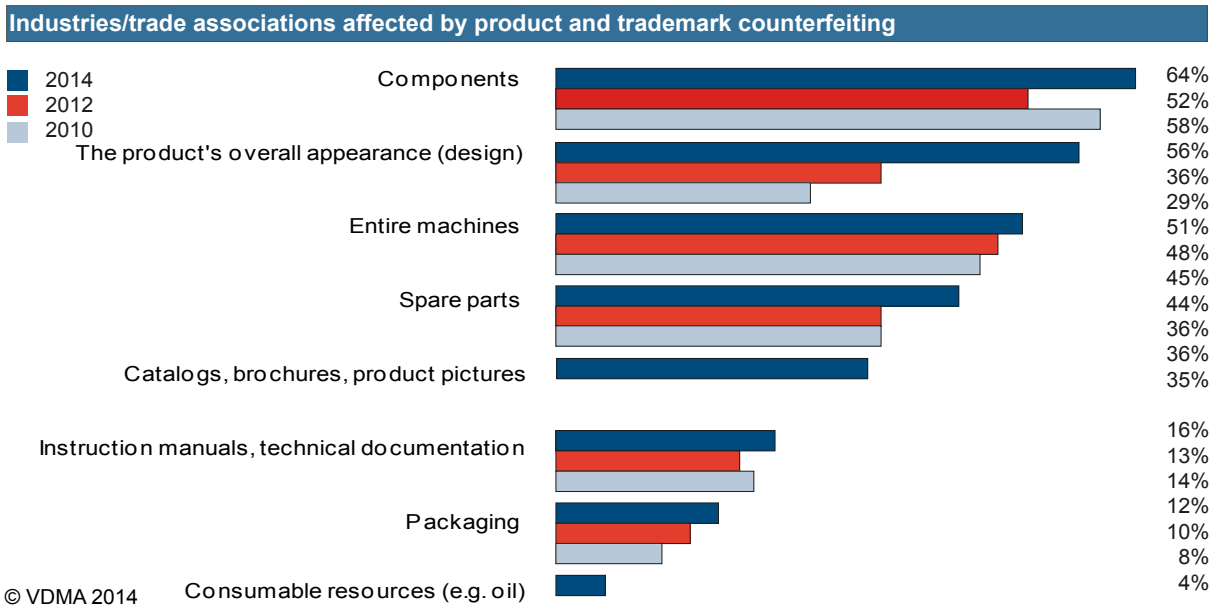
num
CNC HighEnd Applications

Piracy Protection (anti-counterfeiting)

The damage caused to the economy as a result of product piracy is huge: EUR 7.9 billion in 2013 alone, as estimated by the German Engineering Federation (VDMA). According to the 'Product Piracy 2014' study conducted by the VDMA, the majority of counterfeit German products, 72% of them, are produced in China. However, German products are also counterfeited in Germany (23%). Turkey follows in third place at 20% and then India at 19%. Within the mechanical and systems engineering industry, the sectors most affected are woodworking machines (92%), textile machines (86%) and agricultural technology (86%).



Almost two thirds of the parties concerned reported pirated components, followed by counterfeit designs. Counterfeits of entire machines have seen yet another increase. More than half of the companies surveyed have now been affected.

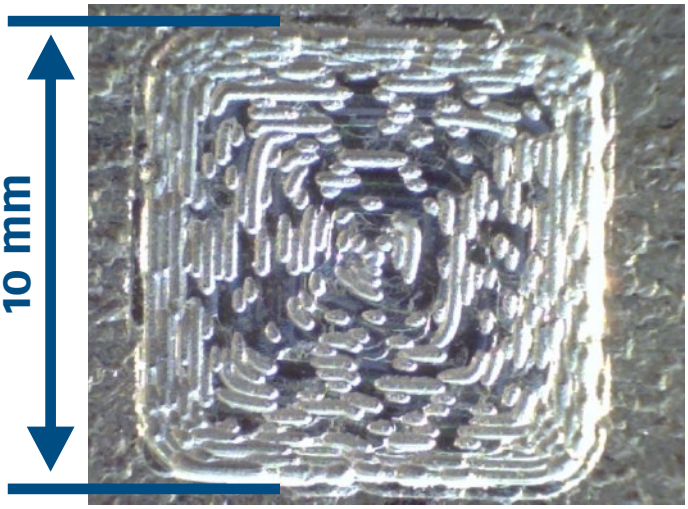


Product piracy leads to lost income and profits, but can also damage a company's image and its innovative advantage. This can result in safety risks and problems with regard to product liability, as well.

Improving protection

Steps to counter product piracy must include a range of different actions. One very important step with which to counteract this problem is offered by NUM in the form of forgery-proof marking of machined components. During metal-cutting manufacturing, a mark is incorporated into the component on a predefined spot. This does not require a dedicated process as the generation of the mark is superimposed – during the finishing process for example. The mark consists of a completely random and thus unique pattern in the form of very fine scores in the material of the workpiece. The mark can be user-specific in terms of size, depth, position and shape. Trying to copy the exact same pattern would be extremely hard and would significantly increase the machining time of the counterfeit. The mark is created by the control system itself (Flexium$^+$). The dedicated function must be activated by NUM and is stored in the control system in encrypted form. If the function has not been activated, the mark cannot be put onto the component, not even on an identical machine type. However, the function can be retrofitted at a later time, because no special control or marking material is needed to generate the marks.

After the mark has been applied, it is captured with a camera and stored in the component manufacturer's database. If anyone wants to check if a machined component is an original part, they simply need to take a picture of the mark using a simple web camera with a zoom lens. They can then compare this image to the database on the manufacturer's website. For this purpose, the picture is broken down into characteristic values that are then compared to the respective values of the original photograph. If they match, this provides confirmation that the component is genuine. This may sound simple, but the process requires application software produced by a specialized company experienced in image analysis.



Conclusion

Steps to counter product piracy must include a range of different actions. NUM offers one solution with a forgery-proof marking on machined components. Additionally, NUM control systems also have other capabilities that prevent special functions from being copied from one machine to another. If a machine manufacturer develops a particular function based on the openness of the NUM control system, this cannot simply be copied onto a pirated machine with a NUM control system and used there. Moreover, such functions can also only be activated by NUM upon request of the machine manufacturer for each machine individually.

Engineering

Local CNC experts help Chinese company to develop radical

lly improved gear cutting machine

NUM China has helped Betek to accelerate the development of a groundbreaking six-axis precision gear hobbing machine. By utilizing a direct-drive spindle and NUM's ultra-precise electronic gearbox and renowned CNC gear hobbing technology, together with a unique HMI developed by a local specialist machine designer, the new Betek YK3132Z gear hobber provides unprecedented cutting speed and processing efficiency. It is up to 10 times faster than conventional mechanical gear hobbers – and more than twice as fast as competitive six-axis CNC gear hobbing machines – and looks set to establish a new performance standard for gear production automation.

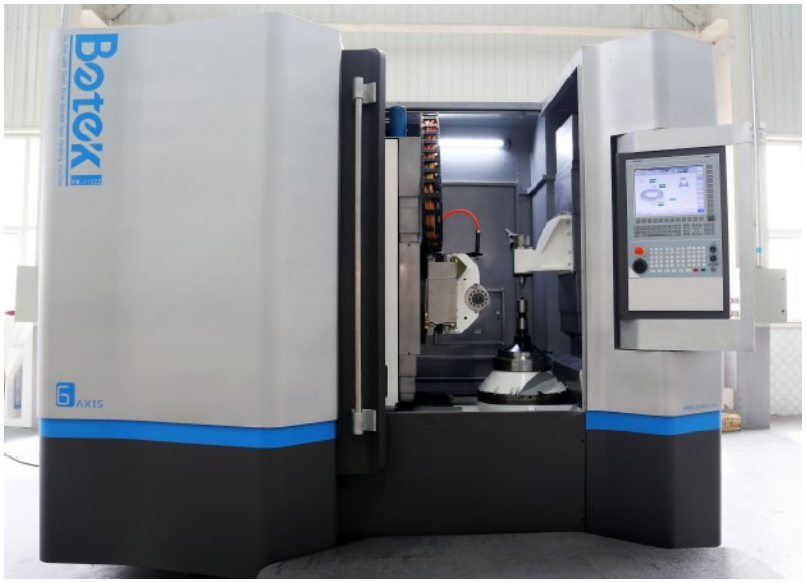
Based in Tianjin, China, Tianjin Betek Machinery Manufacturing Co., Ltd (Betek) specializes in the production and processing of mechanical parts for industrial applications. The company's experience of using machine tools in its manufacturing operations, combined with market research, highlighted major opportunities in the domestic gear production market. China has a growing need for CNC gear cutting machines that combine precision, high processing efficiency and ease of use, to replace inefficient mechanical designs. In 2013, the company took the strategic decision to diversify into the production of gear cutting machines, investing 80 million yuan (approximately 13 million USD) in a 25,000 square meter purpose-built manufacturing plant and offices.

Betek's latest CNC machine tool, the six-axis YK3132Z gear hobber, is now available – less than two years after the start of development. At the beginning of the project, the company looked at CNC systems from a number of manufacturers, and quickly decided to base the machine on NUM's Flexium+ CNC platform.

According to Betek's President and General Manager, Mr Jin Guolin, "Our main reason for choosing NUM's CNC systems for our new gear hobber is that, unlike many competitive control products on the market, they have an open architecture. This provides an unrestricted foundation for development and customization work, helping us to reduce costs and shorten time-to-market significantly. We intend standardizing on NUM CNC for future machines whenever possible – for example, we are currently developing a new gear grinder that will also be based on NUM's CNC technology."

For the gear hobbing machine project, another factor behind Betek's choice of CNC supplier was NUM's extensive experience in gear production applications, which spans several decades. Its CNC gear hobbing solutions, based on NUMgear software, are used by many leading manufacturers of gear production machines. The proximity of NUM's facility in nearby Beijing was also a consideration – it means that Betek benefits from responsive locally-placed applications support and technical service.

Betek's new YK3132Z six axis gear hobbing machine is based entirely on NUM CNC equipment. It uses the latest Flexium+ CNC kernel and high-end

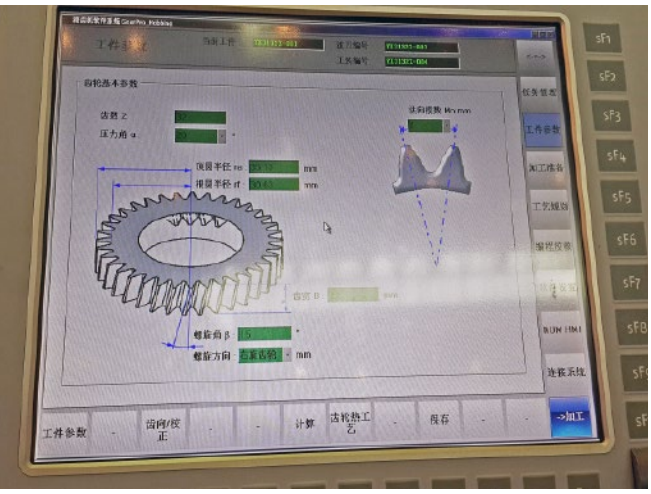


Left and right: Offering unprecedented cutting speed and processing efficiency, the new Betek YK3132Z six-axis gear hobber is based entirely on precision CNC technology from NUM.

Progress

Above: Direct drive motors controlled by NUMdrive X servo drives power the turret spindle and table in Betek's new gear cutting machine.

Below and right: All human interaction with the gear hobbing machine is via a NUM FS152i operator panel, using a custom HMI developed by NUM's partner, Mactool.



NUMDrive X servo drives in conjunction with compact BHX and SHX servomotors; high resolution encoders and closed-loop control maximize accuracy of speed and position. Both the turret spindle motor – a built-in model – and the table (C axis) torque motor are powerful direct drive units that are also controlled by a NUMDrive X servo drive. These motors completely eliminate the need for mechanical power transmission components such as worm and helical bevel gears, resulting in precision, backlash-free movement.

The turret spindle can handle speeds up to 1,200 RPM, while the table can rotate at up to 280 RPM; this allows use of the latest high-speed cutting tools. Accuracy and reliability are further enhanced by the machine's use of high rigidity servomotor-driven precision ball screws for its linear axes.

The NUMgear suite of gear production software that is being supplied includes dedicated hobbing functions and a precision electronic gearbox that allows all master axes and the turret spindle to be fully synchronized. The electronic gearbox minimizes synchronization time by predicting the acceleration rate as well as the speed of the axes.

All human interaction with the gear hobbing machine is via a NUM FS152i operator panel with a custom HMI. The operator panel features a 15-inch high resolution backlit LCD screen with 22 large function keys and contains a powerful industrial PC. The HMI makes extensive use of graphics and is inherently intuitive; users can operate the machine after just a few hours of simple training. Gear manufacturing data can either be input using a simple 'fill in the blanks' method or derived from previously processed parts – the software includes database management functions.

The custom HMI software was developed specifically for the machine by Changzhou Mactool Precision Machine Tools Co., Ltd. This company specializes in the design of gear cutting machines and user interface software, and has invested heavily in building up the development and technical support infrastructure necessary to serve China's nascent precision gear machine tool industry. Mactool's owner, Mr. Haiyu Wang, has more than 15 years of experience of gear processing applications, with a particular expertise in gear hobbing and grinding machines.

Florian Schmidt, NUM's Product Manager, points out that Mactool and NUM China have collaborated on several high value CNC machine projects in recent years, adding that: "To provide our customers with their ideal solution we combine the best of all worlds."

Mr. Haiyu Wang agrees on the benefits of collaboration, "I believe that partnerships provide customers with an enormous competitive advantage. By working closely together, NUM, Mactool and Betek have jointly created a highly advanced precision gear hobbing machine that looks set to enjoy significant market success. Based on a fully proven and stable CNC system, the machine is way ahead of the competition in terms of its usability, efficiency and performance. The excellent production management and quality control systems that Betek has put in place will help to ensure that its customers benefit from a world-

From left to right: Haiyu Wang, General Manager, Mactool, Arno Muller, NUM China, Jan Koch, Exec. VP NUM Group / CSO Asia, Guo-lin Jin, General Manager, Betek, Johnny Jiang, Application Engineer, NUM China and Qingli Zeng, Vice General Manager, Betek.

class precision machine – but at significantly lower cost than comparable products."

The Betek six-axis YK3132Z gear hobber accommodates gear blanks up to 320 mm (12.6 inches) in diameter. Its advanced CNC system can handle five-axis interpolation, enabling complex gear tooth profiles to be created smoothly and efficiently. The entire gear is cut as part of a single process, without interim removal/reinsertion of the gear blank or manual tool changeover.

Virtually any type of gear can be cut, including unusual types such as parallel shaft, herringbone, taper and non-circular gears. For maximum machining accuracy the machine uses dry cutting techniques, capable of achieving Level 6 precision on interim cut gears and Level 3 precision on finished products. Dry cutting also obviates the need for cutting fluid, which is a common form of pollutant in machining industries that requires special treatment and disposal.

Progress

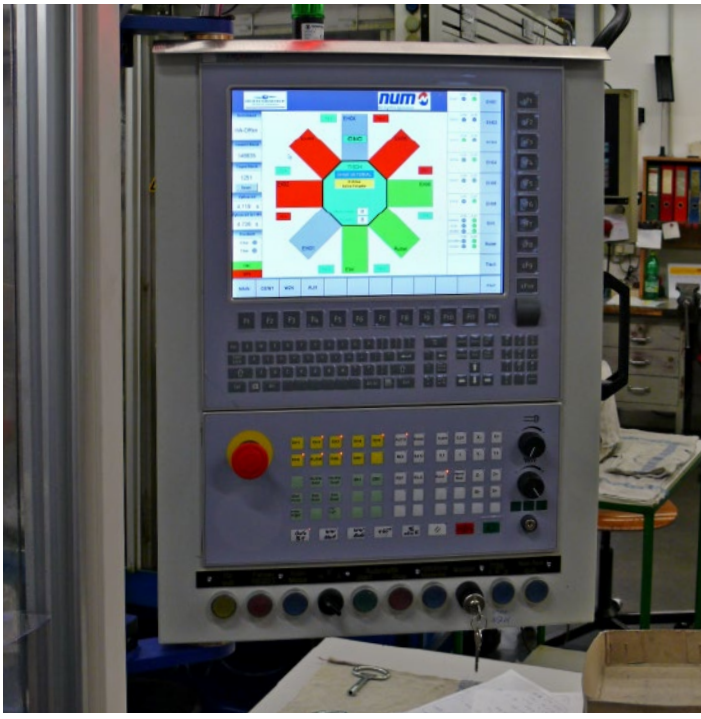
Traditional company produces high-precision components using NUM CNC systems

REDTENBACHER
the fine art of precision

num
CNC HighEnd Applications

In the past, Redtenbacher made a name for itself as a full-service provider for the optical sector. Now, thanks to its consistent accuracy and short lead times, Redtenbacher also distributes precision components to the automotive industry, the medical technology sector and even the watchmaking industry. With the Flexium CNC system, NUM has optimized production on the multi-spindle rotary transfer machines, thus giving Redtenbacher that all-important extra competitive edge.

With around 150 employees, Redtenbacher, a company rich in tradition, has fulfilled its clients' wishes reliably and accurately for over 330 years. Advanced technology is necessary in order to guarantee high precision. This also applies for the production of prototypes and initial series. However, production speed for samples and initial series is also a decisive factor. In order to constantly achieve these targets, Redtenbacher uses machines fitted with numerous CNC axles and the Flexium CNC system to offer the best there is to be had on the global market. With the aid of CNC machines, Redtenbacher is in a position to create prototypes of custom models within three days.



When it comes to series production, assuring high output while maintaining consistently high quality is very important. Redtenbacher relies on the Flexium CNC system from NUM to guarantee high quality with larger quantities. In order to work at maximum efficiency, transfer, rotary transfer and multi-spindle machines used for series production must be optimally designed with the parts to be manufactured in mind. Increasing demand for smaller batch sizes, a higher number of variants and faster reaction times all present ever-greater challenges in terms of the set-up, changeover

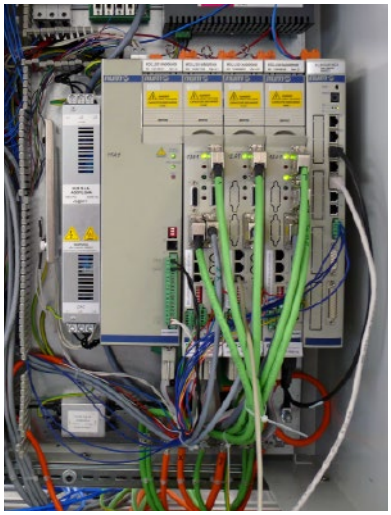
Top left: Customized HMI for Flexium CNC system.

Bottom left: Redtenbacher multi-spindle rotary transfer CNC machine with NUM Flexium CNC system.

Top right: Daniel Almhofer, Project Manager for construction at Redtenbacher, Michael Gramer, Project Manager for electronics and pneumatics at Redtenbacher, and Andreas Lumesberger, Sales Manager at NUM Austria (from left).

Centre: Flexium CNC system, NC core and drives.

Bottom: Examples of Redtenbacher precision components, in this case a hinge for the frame of a pair of spectacles.



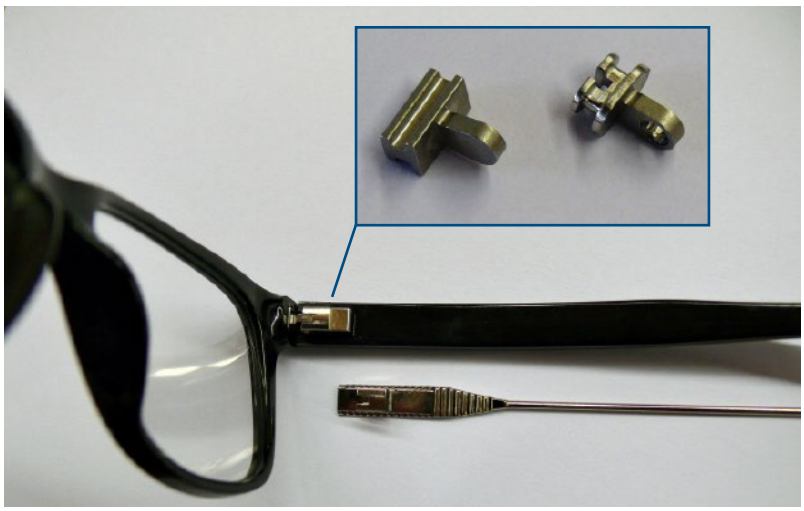
Top Performance

and operation of these machines. In order to be economically viable, they must therefore be flexible and be able to be operated efficiently and in a manner that is transparent and intuitive for the user. The Flexium CNC system allows large quantities of high-quality, highly accurate parts to be manufactured within a very short time frame. Because the Flexium CNC system is so easy to operate, product changeovers and the associated machine set-up can be carried out quickly and without significant interruptions to productivity. The Flexium CNC system has proven itself to be exactly the right tool for the high-performance series production at Redtenbacher.

For a number of decades, NUM has been supplying CNC systems for transfer machines, in use the world over. On the basis of this experience, among other products, the Flexium CNC system was developed. It can be tailored to meet specific requirements for transfer, rotary transfer and multi-spindle machines. The continual development of NUM's open CNC systems in line with user requirements identified during field tests ensures that machine manufacturers' and end users' investments are secure over the long term.

This outstanding quality is not only necessary for series production. In order to guarantee absolute accuracy when producing turned parts, Redtenbacher also uses state-of-the-art CNC automatic lathes, capable of completely machining even the most complicated of parts from a range of materials, including non-ferrous metals, aluminum, titanium and steel. Redtenbacher efficiently and precisely manufactures Redtenbacher turned parts in sizes ranging from 0.5 to 16 mm in diameter, and from 1 to 500 mm in length.

As Redtenbacher writes in its company brochure, "Enormous success is the sum of minor ones. We are proud to present some of ours!" We could not agree more, and we are proud that our Flexium CNC system allows us to contribute a small but integral part to our clients' success stories.



CNC retrofit increases performance of vintage high end machine tool

Jean Gallay S.A. has been in business for over 100 years and is renowned for its high precision metal components. The company manufactures and repairs parts and assemblies for gas turbines, helicopter and fixed-wing aircraft engines, and nuclear reactors. Manufacturing these state-of-the-art parts requires sophisticated technical knowledge, irreproachable quality standards and know-how. That's where NUM appears on the stage as a reliable partner in the field of CNC, to help increase the quality and productivity of CNC machine tools. Jean Gallay's customers include such well-known companies as Alstom, Areva, Safran, MAN and Rolls-Royce.

Jean Gallay is a specialist in precise sheet metal work for manufacturing complex components for use in extreme operating conditions. The company applies outstanding technical expertise, stringent quality control and non-destructive testing to all stages of manufacturing. With over 180 employees, uncompromising standards are maintained at all times to ensure that Jean Gallay products and services achieve the highest levels of precision, quality and reliability.

Like NUM, Jean Gallay operates at the cutting edge of its chosen specialist field. It produces hot gas part sections/collectors, combustion chambers and injectors or burners for gas turbines. The company also manufactures components such as welded casings, honeycomb rings, diffusers and distributors.

The mission for the retrofit of this Duplo Standard CNC machine was not only to modernize the CNC control but also to increase the performance of the machine. Another key consideration was that the new Flexium CNC control by NUM needed to offer backwards compatibility with all the programs that Jean Gallay had developed and written for the machine during the past 20 years, so that they could continue to be used for production purposes in their present form. This is an inherent benefit of the Flexium platform and a significant advantage over competitive CNC systems. NUM's Flexium CNC control system has enabled Jean Gallay to avoid spending many hundreds of hours rewriting all its production programs to suit the upgraded machine.

The CNC machine was retrofitted by NUM with the new Flexium CNC control unit. The machine has 7 axes and

Bottom: finished engine parts of an aircraft turbine.

Below right: detailed picture of the ultra-fine honeycomb structure of the engine part of an aircraft turbine.

Top right: from left to right, Christophe Froidevaux, NUM Engineer, Jean-François Hermann, NUM Sales Engineer, Fernando Martinez from NUM's Bienne office, Philippe Gassilloud, responsible for maintenance at Jean Gallay SA, and Marco Guidi, responsible for technical service at Jean Gallay SA.

Below: Flexium 68 CNC, with NUMDrive C single-axis and dual-axis servo drives.

Bottom right: A factory worker operating the retrofitted CNC machine.

2 spindles, which are powered by 9 NUM motors. With the new CNC control, the machine can be maintained online by NUM's technical staff, in the event of a problem. This reduces machine downtime to a minimum, allowing 24h/day operation to maximize productivity.

As comparatively small to midsize companies in the global market, Jean Gallay and NUM set themselves apart from their larger competitors by means of continuous development, innovative solutions derived through close partnership, strong teams of highly qualified employees and excellent global service networks. These factors are also the basis for the success of the two companies. Saving time and resources by developing innovative production solutions, such as this machine retrofit, enables companies to be as competitive as the big players in the market.

This retrofit project again shows that a good machine, even if it was originally manufactured several decades ago, can be brought 100% up to date technically by a rebuild. The performance of a rebuilt machine is often as good as a new model – in some instances it may even be better due to a higher standard of basic construction – and this approach will cost significantly less than a new machine. Extending the lifetime of an existing machine by another 20 or more years makes sound economic sense, especially in today's competitive market where production costs are becoming more and more important.

Retrofit

High-precision 17-axis laser welding system for the automotive industry

ANDRITZ Soutec AG

In today's market, in addition to efficient production, the automotive industry's primary objectives are to reduce a vehicle's fuel consumption and to improve passenger safety. In plain English, cars need to become lighter and safer at the same time. The laser welding system by Soutec combines these two main objectives by welding different plates of varying thickness and strength. Many of today's cars contain body parts welded by Sutec. For complex, so-called "tailored blanks" and welding seams, ANDRITZ Soutec has enhanced its tried and tested "Soutrac" laser welding machine and equipped it with the latest technology and control system.

The heart of the machine is a 9-axis welding head. With it, even non-linear seams can be welded. The welding head is equipped with rotatable and height-adjustable cameras in front of and behind the welding nozzle, allowing for seam tracking and subsequent quality control, and guaranteeing a stable welding process that meets even the highest quality requirements. Gaps of <0.3 mm between plates are joined dynamically and in high quality during the welding process using filler wire (Soufil).

The welding system is controlled by a Flexium+ CNC system with safety functions and comprises two sections: the welding machine and the loading unit. It has a total of 17 axes. The X-axis of the welding machine is designed as a bridge with two motors, because the workbench with its magnetic fixation and material weighs 1.5 tons. It can be accelerated at 4 m/s2, allowing a start-up performance of 0 to 120 m/min within 1 second. The laser has an output of 6 kW and can weld seam plates of different strength and material. The weld speed is about 10-12 m/min.

The highly dynamic welding system is designed for accuracy and speed using high-precision mechanics and state-of-the-art CNC controls. By working closely together, ANDRITZ Soutec and NUM are helping the automotive industry to increase the flexibility, speed and accuracy of its production processes. Machine retooling is also quick and easy, simplifying product changeover. This minimizes production interruptions, thus further increasing system efficiency.

By acquiring Soutec AG, based in Neftenbach, Switzerland, the Austrian group ANDRITZ was able to expand its product range for the metalworking industry in 2012 and strengthen its global presence. ANDRITZ Soutec is a provider of laser and roll seam resistance welding systems and has been working on devel-

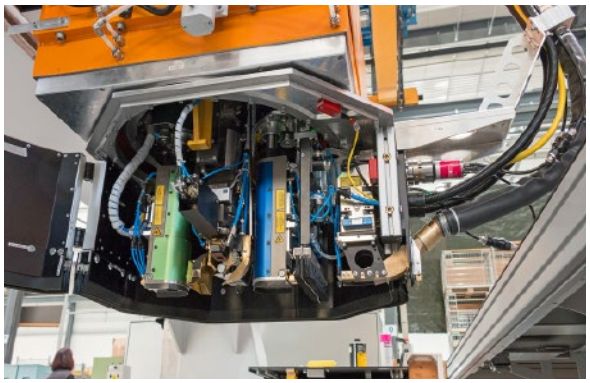
Left: Laser welding system with workbench and magnetic fixation.

Top left and right: 9-axes welding head with seam tracking and quality control system.

Middle left: Konrad Näscher, NUM Application Engineer and Ernst Sigg, ANDRITZ Soutec AG Software Engineer (right).

Bottom left: Welded and shaped body panels.

Bottom right: Control cabinet for Soutrac welding system with the Flexium+ CNC control system by NUM.



oping CNC-controlled equipment in partnership with NUM for close to 30 years. Especially lightweight products, such as the body parts mentioned above, but also fuel tanks or exhaust system components, are produced with the Soutec welding systems at the end user's location. The ANDRITZ Soutec systems are designed to provide optimum support to automotive manufacturers in their continuous efforts to produce safe lightweight vehicle designs while ensuring a high level of profitability. ANDRITZ Soutec has therefore always worked closely with its customers to identify market needs as early as possible and to introduce innovative new products quickly. Case in point is the existing Soutrac system, which was enhanced and equipped to meet current demands.

For Soutec, merging with the ANDRITZ Group was a stroke of luck. The company seamlessly integrated into the Group's structure while keeping its independence. Like Soutec, which started out as a small workshop over 60 years ago, the Group also started small: the foundation of a small iron foundry in Austria in 1852 marked its birth. In order to always be at the cutting edge of technology, ANDRITZ runs several research centers where products and processes are improved and developed to the highest standard. The Group focuses mainly on developing tailored technology solutions. This has always been the case for Soutec as well, collaborating closely with development partners such as NUM and the customer. In addition, the ANDRITZ Group focuses particularly on increased environmental protection, reducing the use of energy and resources in production as well as extending the service life of machines and systems.

High-Quality

Increased quality, quantity and speed + decreased time-to-market: goal achieved

Newlast, in collaboration with NUM, has developed a very efficient milling machine for the planning, prototyping, modification and production of precision shoe lasts, used in the manufacture of high quality footwear. Founded in 1996, Newlast aims to apply the knowledge acquired from years of experience in industrial machine tools to the manufacture of shoe lasts – a field that is notorious for time-consuming and obsolete working practices. By adopting NUM's advanced CNC systems, Newlast has enhanced the performance of its machines significantly, placing the company amongst the world leaders in this sector.

Newlast's aims are to provide customers with machines that improve manufacturing precision, decrease time-to-market and save on operating costs. Simplification and standardization of production processes, with on-line data exchange, are also important. Like NUM, the underlying principles which have gained Newlast a worldwide reputation for its technology are quality, innovation and research. NUM's objective is to cooperate closely with machine builders to provide CNC solutions that give them a competitive advantage in the market; in this case, NUM has helped Newlast to improve the performance of its new last milling machine so that it offers faster production processing capabilities and increased accuracy. More lasts can now be manufactured in less time, with high precision and quality.

The SDRF1HS is a new generation machine designed to produce shoe last models. By means of this product Newlast has responded to the requirements of stylists and designers of footwear manufacturers and last making factories, who are increasingly inclined to use technological products to carry out their creative work of producing physical prototypes of lasts. Starting with a roughed block of plas-

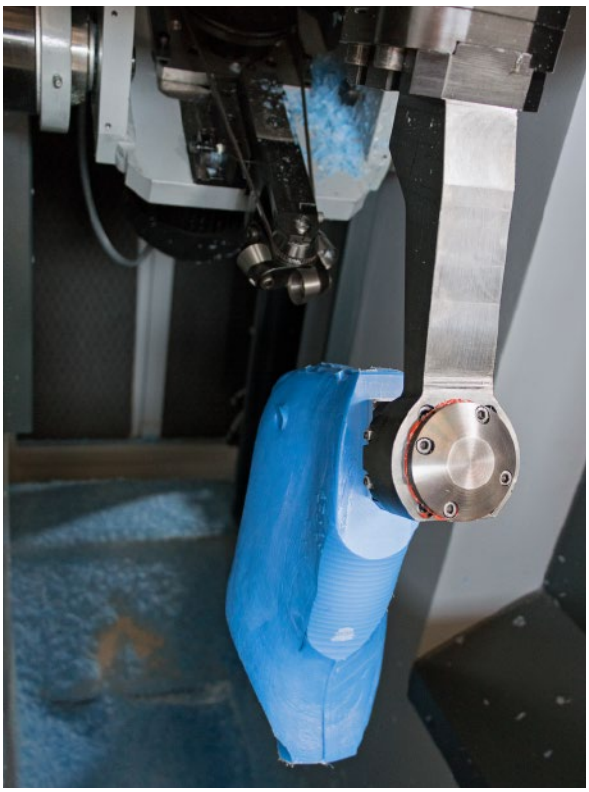
Above: capacitive multi-touch-screen with the Flexium HMI of the NUM CNC control.

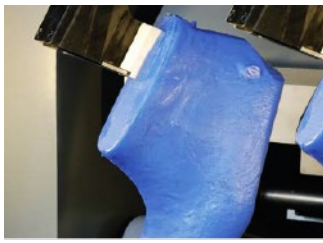
Left: SF6HS last milling machine with NUM CNC Flexium control.

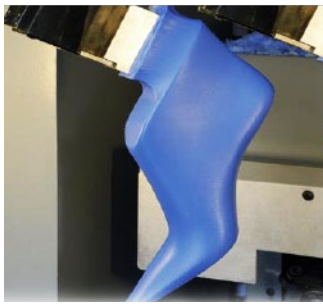
Near right: Production involves precision milling of a complete last. Starting with a roughed block of plastic or wood, the SDRF1HS machine produces a model – for a left or right foot – in just one working cycle.

Far right: Complete working of the last without manual operations to remove the toe and heel supports.

Below: Pietro De Bernardi (right), Engineer at Newlast and Marco Battistotti, Director NUM Italy, in front of the SDRF1 last milling machine.







tic or wood, the SDRF1HS machine produces a complete model – for a right or left foot – in just one working cycle. The result is a fully formed precision-milled last, which is produced without need of any manual processing work to remove the toe and heel support. The machine's CNC software automatically calculates the optimum tool path to maximize efficiency and throughput. With the same technology Newlast produces machine for one pair, two pairs and three pairs of shoe lasts, all equipped with NUM's Flexium CNC. By adopting NUM's Flexium CNC platform, Newlast is ensuring that its machines are equipped with a high performance numerical control for the rapid milling of shoe lasts, using digital communication between the motorized axes and drives for precise, interference-free operation. The motors are fitted with absolute encoders, in order to avoid homming the machine at the machine power-up. The control solution – comprising drives, motors and CNC system – is the result of a collaborative development effort and is based entirely on technology provided by NUM. This means that Newlast's customers can receive help from NUM's worldwide service and support network very quickly, should they so need.

In addition to its extensive range of shoe last milling machines, the Newlast group produces equipment and software for numerous allied areas of footwear design and manufacturing. These include 3D laser scanners for orthopedic and shoe manufacturing applications, manual and fully automated structured light optical digitizers for scanning lasts, soles, heels and shoes. Software products include a package for managing the setup of shoe last injection molding, as well as a powerful CAD/CAM system for designing 3D models of shoe lasts. The group also collaborates on a technical basis with the Swiss company UTD, creator of the RightShoes SA platform – which helps consumers to choose the correct size of shoes without needing to physically try them on. We wish Newlast continued business success and assure them of our further collaboration with this revolutionary new project!

Efficient

Cutting edge technology, ingenuity and customer proximity

The headline at the top of this page cites the three factors which comprise the philosophy for success shared by Fraisa and NUM and have made the companies leaders in the global market for cutting tools. This philosophy, in combination with the companies' mutual experience and trust, has resulted in a solid partnership in the tool machining sector which has lasted for 25 years. Both companies maintain their own research and development departments which strive to always keep a step ahead of the market. Fraisa's leading position in the high-tech tool market – as well as its firm commitment to training and development – recently came to the attention of the Swiss Federal Council, and the President of the Swiss Confederation made an on-site visit to receive a detailed demonstration of modern tool production.

Cutting edge technology – Fraisa's high-performance tools and comprehensive range of services enable its customers to increase productivity and lower costs. Fraisa provides these customers benefits through the use of NUMROTO, the comprehensive tool machining application developed by NUM. NUM is constantly working in close collaboration with Fraisa to bring new enhancements to the software so that it always meets current needs in production. One example of these enhancements is provided by the high-performance AX-RV end mills mentioned in this article. These tools make use of 3D simulation to ensure they are already "electronically balanced" by the time they are programmed. This balancing is so precise that mechanical balancing can be done away with, thus saving setup costs and time.

Another highlight is that tool grinding machines can now be linked to SAP systems. This allows companies to monitor production centrally and create logs of production data at any time.

Ingenuity – creates stability, ensures transparency, saves time and reduces costs. This in turn guarantees higher productivity and greater efficiency. Ingenuity is also why NUMROTO is an open, user-friendly application which can be continuously adapted (i.e. programmed) to the current needs of the application.

Customer proximity – Fraisa maintains its own training center where customers work directly on machines to keep up to date with the latest machining technology.

Left: The new high-performance AX-RV end mill is setting new standards in milling integrated aluminum components. The AX-RV was developed by Fraisa in close collaboration with industry partners.

Top right, from left to right: Flavio Gugelmann, Director of Production Technology at Fraisa, Stefan Gutmann, Director of Production and member of the Executive Board at Fraisa, Adrian Hangartner, Director of Manufacturing and Learning Technology for Development at Fraisa and Jörg Federer, NUMROTO Application Director, NUM AG.

The same is true of NUM, which also makes customer visits and provides on-site instruction at customer production units, in addition to providing training sessions on NUMROTO.

As mentioned above, Fraisa produces cutting tools for metal working for the global market. Founded in 1934 by Johann Stüdeli, Fraisa started out producing milling tools for the watch and clock making industry. This laid the foundation for the present Fraisa Group. Today, with 520 employees, Fraisa ranks among the leading manufacturers in the industry. Fraisa Holding AG is represented worldwide with 6 branches. Fraisa SA in Bellach, Switzerland has been the headquarters of the company since it was founded, and also handles production and development of the company's entire range of milling, drilling and threading tools. In addition to Switzerland, Fraisa also has branches in Germany, France, Italy, Hungary and the United States. Fraisa's collaboration with NUMROTO began 25 years ago, at the time the first tool grinding machine was delivered to the Bellach plant. Since then, the company has significantly expanded its machine facilities, not just in Switzerland but also in its branches in other countries.

New AX-RV tools bring high performance to aluminum end mills

The technological innovations of AX-RV brings superior results, maximum productivity and minimal machining costs per tool. Less vibration and a smooth run ensure a higher degree of process stability. Minimal setup costs and times are achieved thanks to pre-balanced tools. Higher automation capacity is realized through reduced inspection intervals and longer tool lifetimes. Improved component quality is achieved thanks to process-stable runs and better transfers during downfeeds.

Below from left to right: Fraisa SA, in Bellach, Switzerland, is the headquarters for the company and also handles production of its entire range of milling, drilling and threading tools. The company's administration, management, marketing, research and development, logistics and Toolschool divisions are also based in Bellach. Fraisa Hungária Kft in Sárospatak, Hungary is an ultra-modern 4,000 square meter plant which produces top-quality carbide tools for the Fraisa Group's customers.

High-Precision

Customized CNC upgrade simplifies railcar axle grinding

CNC Upgrade

A comprehensive upgrade of classic high powered centerless grinding machine tools is helping a leading railcar axle manufacturer to greatly simplify precision grinding operations on axle forgings. A key element of the project – which has been managed by APeC Integration Services, Inc – is the retrofit of customized CNC control based on NUM's powerful Flexium platform.

Based in Wattsburg PA, APeC is an electrical systems integrator specializing in upgrading machine tools with modern PLC and CNC systems. Established in 1989, the company has built a reputation for enabling clients to maximize the longevity and performance of their machine investments. Key retrofit services include upgrading servo and spindle motors and drives, PLC integration and custom machine controls, and complete CNC replacement.

The machine tools in this particular project are high capacity Landis centerless grinders, which utilize a dressable grinding wheel and a plunge grinding cycle to create precision profiles on railcar axle journals. During grinding, both the axle workpiece and the grinding wheel rotate in the same direction, which means that the two surfaces are moving in opposite directions at the point of contact, resulting in smoother operation. Once the machine is up to speed, the grinding wheel is fed – or 'plunged' – into the workpiece and makes continuous contact with a single point along its length. The plunge action is controlled by a servo-driven axis grinding at several feed rates, with transition points monitored by in-process gauging. A built-in automated two-axis dresser system with a diamond tipped tool is used to dress the grinding wheel whenever necessary.

This is the second time that APeC has improved the performance of these grinders with control systems based on NUM CNC kernels. The original machines were hydraulically actuated and equipped with tracer type wheel dressing systems. In the mid 1990's, APeC performed a full mechanical and electrical upgrade on each machine that included retrofitting a modern CNC system and in-process gauging instruments. On that occasion, the company based

Left: The machine's plunge grinding cycle is controlled by a servomotor-driven axis, utilizing feedback from a linear encoder.

Right: The machine grinds precision profiles on railcar axle journals.

Above: The machine's new control console incorporates a Flexium operator panel with a touch-sensitive display screen.

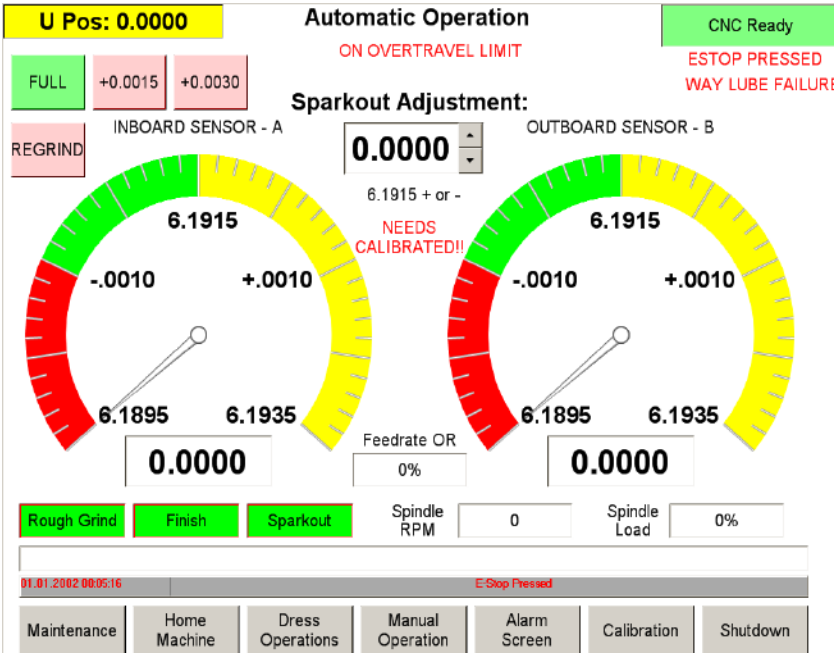
Below: Extensive mechanical and electrical upgrades to this Landis centerless grinding machine include a new Flexium CNC system from NUM.

the upgrades on NUM's Power 1060, which at the time was regarded as one of most flexible and user-friendly CNC systems on the market.

After a further 20 years' full-time service in a busy production environment, the machines became due for another mechanical and electrical upgrade. APeC had supported the machines and worked closely with their operators throughout this period, during which time it had also developed a number of ideas for making the machines even easier to operate and more productive. The upgrade program offered the ideal opportunity to put many of these ideas into practice.

To expedite machine upgrade and minimize the impact on its customer's production schedules, APeC managed a three-way development partnership. All major mechanical re-design, hydraulic, lubrication, and geometrical rebuilding aspects of the project were handled by EURO Machinery Specialists, Inc., a company with 45 years' experience of refurbishing and modernizing high value metal cutting machine tools. On the control side, APeC collaborated with NUM USA to develop a unique and intuitive human machine interface (HMI). This enables operators to learn how to use the machines very easily and quickly – even if they are unfamiliar with these types of grinders. Customer benefits include improved worker satisfaction, less need for training and increased machine productivity.

According to Dave DeCoursey of APeC, "A key project goal was simplifying machine operation as much as possible. NUM's open Flexium CNC platform provides the control flexibility and HMI customization facilities that we needed to develop individual, task-oriented screens. The user interface is consequently now much more ergonomic. Most operations, such as offset calculations, calibration, dressing and automatic grinding cycle initiation, are now performed using single, virtual pushbuttons that are only displayed when appropriate."



Right: During grinding, the main control screen displays two large analog-style dials which allow the operator to monitor the tolerance of axle taper very easily and accurately.

Each machine upgrade uses several NUM products, including the CNC kernel, touch-sensitive operator panel, servo drives and motors. The Flexium CNC system uses EtherCat I/O communications, making it simple for APeC to implement an advanced plunge depth control architecture. The in-process gauging instrumentation previously used for this aspect of machine operation has been replaced by a linear encoder, which facilitates fast and accurate depth control, as well as providing real-time feedback to the operator throughout the grinding cycle. The main control screen features two large analog-style dials, supported by digital displays, which derive their input data from separate measurement probes located along the length of the axle journal, allowing the operator to monitor taper tolerance very easily.

The client- and application-specific HMI software that APeC has developed for the grinding machine upgrade is task oriented. It uses individual screens that are tailored to the application, with clear context-sensitive functions that help to prevent human error. By using the Extended NCK Access (ENA) facilities of the Flexium CNC controller, each custom PLC-driven visualization can control and monitor the CNC functions directly. This form of control approach is especially useful for automated teach type functionality, such as guiding an operator through machine start-up and preparing for automatic cycles.

For example, the start-up screen initially displays only the status of the CNC system and a single 'Shutdown' button. As soon as the CNC system indicates that it is ready, the start-up screen displays two additional buttons: Home Screen and Manual Operation. When the operator touches a displayed button and causes a change of screen, the software automatically alters the CNC mode accordingly and selects the corresponding part program, if applicable. By confining the operator's available options to just those that are appropriate at the time, the software helps to ensure consistent and efficient machine use.

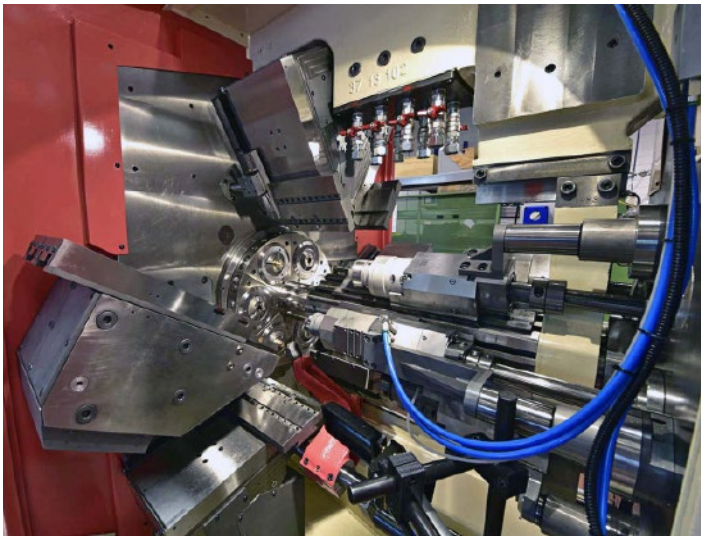
Another major advantage of this type of control approach, with extended access to the NCK, is that it can be used to help the operator with tool offsets and adjustments to part program dimensions. When the grinding wheel or dressing tool is replaced, the operator can manually position the tool on the desired surface of the wheel, access a password-protected screen and then simply press a button. The offsets are calculated and pushed into the dressing program automatically, using the ENA facility. This same facility allows the operator to alter dressing dimensions and sparkout setpoints simply by adjusting a value up or down – these are then pushed into the corresponding part program.

Steven Schilling, General Manager of NUM Corporation in Naperville, Illinois, says, "The open architecture and advanced functionality of Flexium CNC systems enable engineering companies to implement innovative machine control solutions for retrofit or new machine tool projects. In this instance, APeC and Euro Machinery Specialists, with NUM's support, have created a CNC retrofit that adds significant value to the customer's existing manufacturing facilities."

CNC Upgrade

Close development cooperation helps customer to gain market advantage

AUTOR engineering, in close cooperation with NUM, has helped the quality precision manufacturer MMV (Minuteria Meccanica Valsesiana S.r.l.) to gain a significant market advantage by shaving several seconds off the production time of individual turned parts and components. The project provides an excellent example of how smaller companies can successfully compete with larger ones for a share of the world market, by working together in engineering to improve machines and processes until the desired result is achieved.



MMV has manufactured high quality precision turned parts since 1981, initially mainly from brass. Nowadays the company carries out a wide variety of machining operations – such as turning, boring, milling, threading and broaching – on an extensive range of materials, including brass, aluminum and machine steel. Based on clients' drawings and with the help of the latest computer-aided 2D and 3D manufacturing equipment, MMV produces small precision turned parts from round, hexagonal or square drawn rod.

MMV's production is widely diversified and the items that it manufactures are used in many different sectors, including automotive components, industrial valves, chromed taps and fittings, heating and solar power systems, pipes, electrical and electronic equipment, and fixture and fitting systems.

At the end of the production cycle, every part undergoes rigorous degreasing with modified alcohol in special ultrasonic cleaning machines; these use vacuum technology and have zero atmospheric emission. State-of-the-art machinery, run by

Above: The loading zone where the incoming bars get cut into small workpieces, so that production can start.

Left: The complete AUTOR AGM 635-642 CNC multi-spindle automatic lathe machine, showing its bar separation and loading facilities.

Right: (from left to right) In front of the CNC multi-spindle automatic lathe machine, Mr. Stefano Ronzoni, Director AUTOR s.r.l, Mr. Marco Tosi, Director MMV s.r.l. and Mr. Marco Battistotti, Director NUM Italy.

Below: An employee operating the machine via the NUM Flexium 68 CNC control panel.

Below middle: The raw bar material from which individual components are made.

Bottom: Individual finished workpieces as they come out of the machine.

highly skilled and specialist technicians, enables MMV to offer its customers high capacity production capabilities. These are backed by comprehensive SPC (statistical process control) and quality management systems – the company is approved to UNI EN ISO 9001:2008.

AUTOR engineering designs and manufactures complete CNC multi-spindle automatic lathe machines, together with auxiliary equipment and multi-spindle accessories. Its employees, like those of NUM, have many years' experience in this area and use the most up-to-date technologies and measurement instruments – at both the design stage and in manufacturing. AUTOR engineering harnesses these skills to plan and design multi-spindle automation solutions for some of the most important manufacturers in the world. For more than 10 years, the company has continuously renewed its extensive range of equipment, which includes tool holders and appliances such as pick-up spindles and frontal milling attachments. Most of these products are equipped with computerized numerical control.

In close cooperation, AUTOR and NUM have improved the performance of the CNC transfer machine seen here (a CNC multi-spindle automatic lathe machine). MMV uses this machine to produce precision turned metal components for the air brake systems of automobiles and trucks. Various stages of the machine's operation have been accelerated, to the point where the time to produce each individual part has been reduced by several seconds. Extrapolated over a 24-hour production period, MMV now gains several thousand additional parts in this time, making it more market competitive.

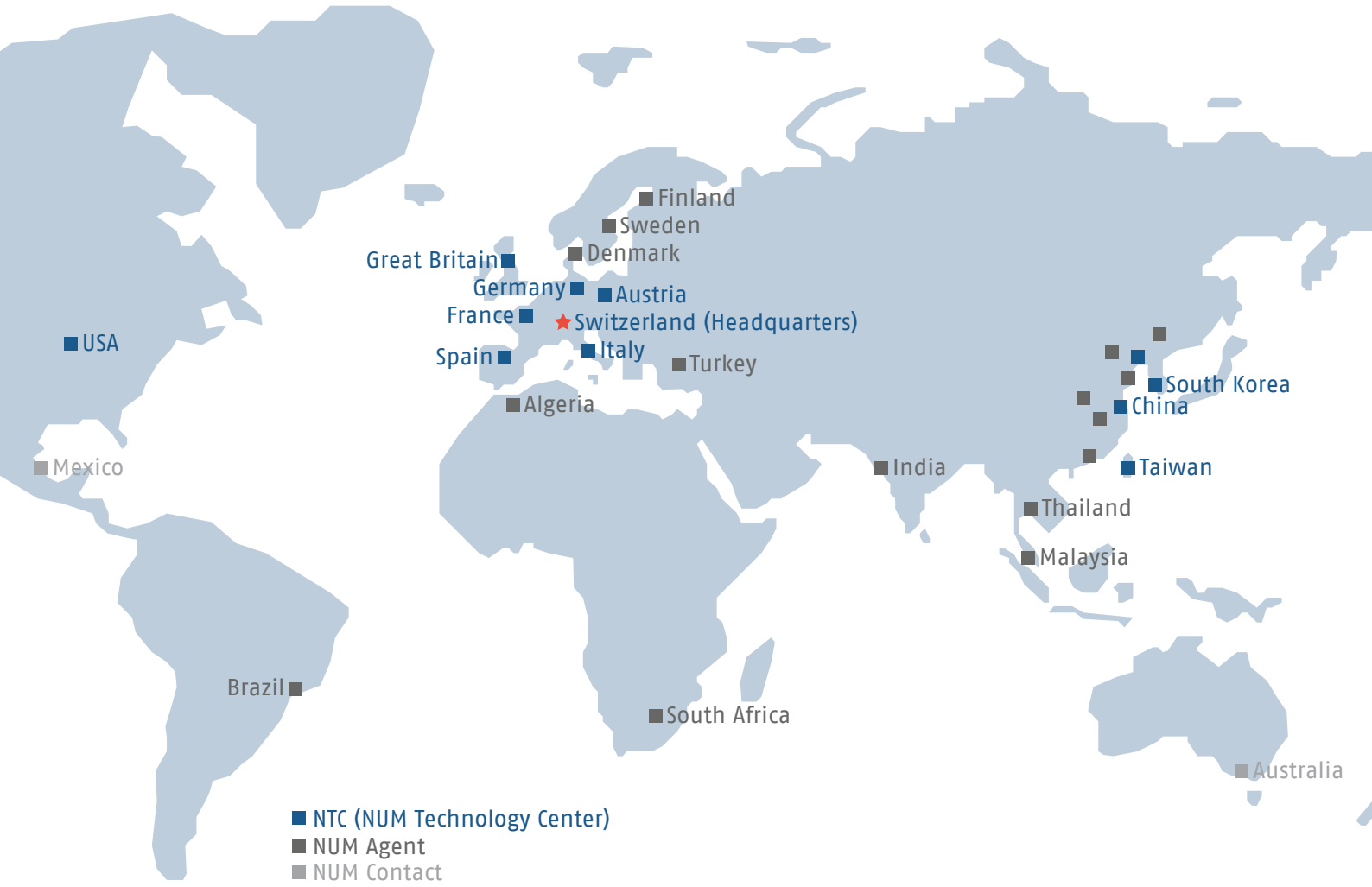
The CNC transfer machine has been built entirely by AUTOR, with the CNC control developed and supplied by NUM. Based on a Flexium 68 CNC control unit, it has 19 axes and 3 spindles. This is the first of a new line of automatic multi-spindle lathes from AUTOR, able to process 35 mm and 42 mm metal bars. Considerable attention has been paid to the flexibility of use and accuracy of the new design, which offers reduced setup time, with lower investment and maintenance costs. Development of new dedicated accessories is continuing to broaden the range of processes that can be executed by the machine.

NUM aims to help every one of its customers gain a market advantage. This is best achieved through close cooperation between the machine builder, the customer who will use the machine, and NUM. Not only will we supply the CNC system, motors and spindles, but we will also provide the essential know-how that forms the basis of successful high end CNC production automation. Depending on customers' requirements, we can either supply this expertise in the form of a complete engineering package, or as individual software components for the CNC control.

High-Speed

Complete CNC Solutions Worldwide

CNC HighEnd Applications



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Our global network of sales and service locations guarantees professional service from the beginning of a project to its execution and for the complete life cycle of the machine.

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