

A close-up photograph of a CNC lathe tool cutting a metal part. The tool is a long, thin, silver-colored metal rod with a sharp, pointed tip. It is positioned vertically, cutting into a cylindrical metal workpiece. The workpiece is rotating, creating a series of concentric, curved ridges on its surface. The background is a blurred, light blue and white gradient.

num*hsc*

**TOTAL SOLUTION FOR
5-AXIS MACHINING
AND HSC**

www.num.com

NUM  [®]
CNC HighEnd Applications

NUM Solutions and Systems

Established Worldwide

Outstanding solutions in machine automation have one thing in common: They are always the product of outstanding performance, exceptional technologies and a high degree of creativity!

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Worldwide at your Service



NUM has earned its exceptional reputation in the machinery and tools industry exactly with that. We develop **customized automation solutions** that ensure a high degree of added value both to the machine manufacturer and the user. With our expertise that we have developed over decades, we put our motto "NUM automation solutions provide machine builders with a competitive advantage" into practice. NUM had already developed the first CNC controller in 1961, i.e. 10 years before CNC- or NC control systems found a wide acceptance among users. With the launch in 1964, **NUM was one of the first CNC providers in the world.** Since then, we have maintained our position as a technology leader in this segment and are eager to expand it further. Today's systems, with their flexibility and our expertise, enable us to automate a large variety of machinery. Our long, successful track record supports this finding in an impressive manner. We will continue to develop the **performance, functionalities and flexibility** of our systems in this direction and make the necessary investments in our products, our research & development, as well as in our staff

As an **international company** headquartered in Switzerland; we have sales, application development and service locations all over the world (see back cover) from which we operate worldwide. Our research and development departments are located in Switzerland, Italy and France. Our main production facility is located in Italy.

It is our clearly defined **vision** that we keep the **development and manufacture** of the core products in the CNC system, including the drives and motors, **under our control.** This enables us to adjust the performance, functionalities and flexibility of our systems to new market requirements very quickly and without delays.

The ready and flexible NUM automation systems combined with our locally available engineering expertise and the machine manufacturer, results in a uniquely flexible and powerful team.

Customized Projects

NUM tailors its support to your projects, ensuring it aligns perfectly with your business and infrastructure needs. Regardless of the specifics, our ultimate goal remains unchanged: collaboratively finding the most efficient solution for your project.



Project facilitation PRODESIGN

Efficient consulting for optimal application solutions

This model is ideal for companies with their own development teams and automation specialists. As an external partner, we provide our expertise and resources in field of CNC automation and take on an advisory role.

Project cooperation CODESIGN

Merging knowledge – potentiating results

Your development team will be combined with our team of specialists. Together we will realize the automation of your machine with clearly defined responsibilities. This form of cooperation has proven to be extremely efficient in many projects.

Total solutions ALLDESIGN

Delegating responsibility – controlling result

We assume the entire project management in the sense of a general contractor and are fully responsible for the successful implementation. Starting with the development of the requirements specification, over the development and commissioning, up to the support and service of the machine, and beyond

NUM Solutions and Systems

Intelligent and Creative

We have developed countless customer- and application-specific solutions for different industries as well as pioneering complete solutions for various industries, thus creating practical solutions for challenging applications and professional requirements.

All of our solutions are based on a wide range of perfectly matched proprietary products such as CNC, drive amplifiers and motors. The partnership with our customers in the evaluation, project and installation phase is further maintained by our training, support and other services even after commissioning. We attach importance to ensuring that our customers are served by our professionals with specific knowledge.



numroto

NUMROTO – successful trendsetter in high-precision tool grinding for many years

numspecial

NUMspecial – creative and practical solutions for your specific applications

numcut

NUMcut – a complete solution for advanced cutting machines

numgear

NUMgear – intelligent total solutions for new machines or as a retrofit in the field of gear machining

numtransfer

NUMtransfer – economical and flexible for all lot sizes for transfer, rotary transfer and multi-spindle machines

numhsc

NUMhsc – excellent quality at the highest speeds on machines with 5 or more axes

numgrind

NUMgrind – grinding and dressing cycles, with intuitive shop floor entry screens and 3D visual validation

nummill

NUMmill – flexible solution with a graphical interface for extensive milling cycles, including full 3D simulation

numwood

NUMwood – long tradition with powerful complete solutions in woodworking

numretrofit

NUMretrofit – rational extension of the service life of your machine by years

NUMhsc – First Choice for High Speed Cutting and 5-Axis Machining

Exceptional performance for extraordinary requirements – that’s the driving force behind the development of NUMhsc. Successful companies in high-tech sectors have trusted NUM’s complete HSC solutions for many years.

The NUMhsc solution seamlessly integrates state-of-the-art technology for the entire system with extensive specialist know-how and application expertise. Each NUMhsc solution is built on powerful in-house-developed hardware, complemented by a suite of software functions specially crafted for the application. Our specialists assist machine manufacturers in defining and fine-tuning the HSC solution to precisely meet their requirements, ensuring maximum performance, precision, speed, and surface quality. Tailoring and optimizing both the hardware and software for each specific application result in unparalleled results.

NUM’s CNC systems have consistently set themselves apart with their openness and versatile communication capabilities, a legacy that has been continually enhanced from one controller generation to the next. The current CNC generation, known as Flexium, is PC-based and offers a broad spectrum of communication options, meeting the essential requirements for a potential Smart Factory. Horizontal integration primarily utilizes fieldbuses like EtherCAT or CAN. Vertical communication with SCADA, MES, and ERP systems can be achieved through the NUM IloTgateway (OPC UA, MTCconnect, MQTT). Additional communication interfaces can be implemented using the corresponding SDKs.

The machine operation was designed for sophisticated applications and boasts a clear, well-structured interface. Even the most complex forms can be easily programmed, and the logical user structure significantly simplifies operations on the machine.

NUMhsc – high-performance as a principle

NUMhsc – team work in all areas

In 5-axis machining and high-speed cutting, maximum performance is essential for all components. The typical technical base is exceptionally rigid, incorporating an effective shock absorption system tailored for this application. To meet the high standards of quality, dynamics, and speed, a robust construction and suitable clamping are necessary. The spindle, which must

be both rigid and cooled, undergoes precise manufacturing and balancing. Housed in a dynamic motor capable of accommodating a broad range of applications, the spindle reflects the exacting demands on the machine. Specialized brackets and tools crafted specifically for HSC underscore the machine’s ability to meet these stringent requirements.

NUMhsc serves as the perfect complement for machines designed to the highest degree of precision. Every element is specifically crafted for HSC applications, encompassing the CNC, servodrive, motors, along with the associated dedicated software, intelligent algorithms, and interpolations. NUM underscores the significance of creating an impressive overall system rather than excelling in a single field. We embody perfection in surface quality, speed, and efficiency, even for challenging procedures.

Our success can be seen in the workpiece

Precision in the fine adjustment of all machine elements, combined with first and second-grade precision interpolation in the servo motors, ensures the highest level of machining quality. The straightforward operation of NUM’s CNC systems makes achieving this performance easily accessible. In the following pages, we highlight some of the functions that illustrate the perfection embodied by NUMhsc.

Intelligence for exceptional precision and surface quality

NUMhsc can be easily integrated into your company’s network and therefore your production system. CAD/CAM data can be imported directly into the system and is then processed by exclusively developed algorithms for production and precise interpolation in the servodrives. In this way, NUMhsc is able to achieve a surface quality which meets the very highest requirements.

High-precision contours

A comprehensive set of specific software developments is employed to achieve high-precision contours. The Look Ahead

NUMhsc – First Choice for High Speed Cutting and 5-Axis Machining

function, for instance, facilitates efficient material removal by anticipating and processing commands in advance. Jerk Control (smoothed Jerk) not only prevents chatter marks but also allows for higher speeds and significantly enhanced surface quality. Special algorithms play a crucial role in increasing the position accuracy of the control during high-speed machining, reducing geometry errors, and enabling the smoothing of otherwise “choppy” movement paths.

To compensate for machine tool errors, NUM’s CNC systems address factors such as imperfect geometry and dimensions of machine components, axis alignment errors, and motion errors of linear or rotary axes. They also consider thermal deformation, as well as dynamic or structural deformation of the machine under load. As part of their features, these CNC systems provide a Volumetric Error Compensation function (VEComp), a real-time application specifically designed to compensate for spatial machine errors.

The Advanced Resonance Suppression (ARS) in the servodrives is designed to compensate for active instabilities in the machine, significantly suppressing resonance. Additional filters and functions are also at your disposal to further enhance the rigidity of the drive. Collectively, these functions contribute to the improvement of curve and edge quality, ensuring precise execution of instructions.

Intelligent algorithms for the highest quality

RTCP

The RTCP (Rotation Tool Center Point) function, originally introduced to the market by NUM, stands as a crucial component in CNC machining. RTCP ensures the continuous positioning of the tool tip within the workpiece. The post-processor calculates the position of the rotating axes, while the CNC executes real-time geometric transformations to maintain optimal cutting conditions. This results in reduced machining time, enhanced surface quality, and reduced strain on the tool. Direct support is pro-

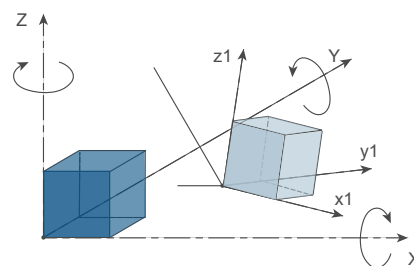
vided for over 20 different kinematics, with the capability for our team to create additional ones. Multiple kinematics can be employed in the same machine, especially when different milling heads are in use.

Inclined plane

The inclined plane function significantly simplifies and shortens the programming of complex forms. In addition to the six standard levels in the XYZ coordinate system, an inclined plane can be generated at any rotation angle. This allows the programming of the workpiece contour in a manner similar to a normal level, eliminating the need for complex spatial thought processes by the programmer. If the program is interrupted during production, the “Inclined plane” function remains active, enabling the user to manually maneuver the tool out of a drill hole, for instance, in case of a break. It is also possible to use the RTCP function within the “Inclined plane.”

Workpiece positioning compensation

When positioning a workpiece on a machine, achieving perfect alignment can be challenging due to factors like weight, structure, prior machining operations, or other reasons. Shifting parallel to the main axes is manageable and requires a simple offset adjustment. However, addressing a tilt can be more complex as it involves compensating for the tool orientation. Traditionally, after identifying offsets and tilt angles, reprocessing the program is a common solution, but this takes time. NUM offers cycles and parameters specifically designed for easy workpiece alignment or compensation. The HMI includes a dedicated page to assist the end-user in verifying the settings. The advantage lies in not altering the part program; instead, the



NUMhsc – First Choice for High Speed Cutting and 5-Axis Machining

3D simulation and 3D collision monitoring

In addition to providing a perfect simulation of the complete workpiece, the software offers versatile functionalities such as measuring geometric features, creating cross-sections of the workpiece, and analyzing the volume of material removal for each machining process. The 3D collision monitoring function is a valuable tool that examines the entire machining process for collisions either upon command, through fully automatic operation, or in parallel with CNC file transfer. Even with normal workpieces, the collision check only takes a few seconds.

In manual operating mode, online collision monitoring proves to be a crucial tool in preventing machine damage, especially when inclined plane or RTCP is active, where some axis movements might be unexpected. The “online collision monitoring” function continuously supervises the axes’ movements in manual mode. In the event of a potential collision, it proactively stops the axes’ movement, helping the end-user avoid costly mishaps.

NUM CNC Systems: The modern heart of NUMhsc

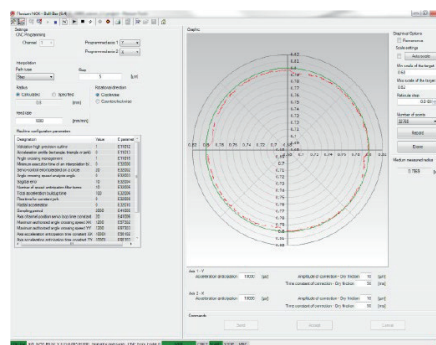
Each NUMhsc solution provides a selection of CNC performance levels tailored to best suit specific applications. The Flexium control generation is particularly noteworthy for its exceptional high performance and flexibility, serving as a key element in NUM’s solutions and systems. It is recommended for its compact dimensions, reduced power input, efficient modern processors with high computing speeds, and an intelligent structure that allows for further extensions. Features such as the reload mode and very large memory ensure continuous operation for comprehensive programs. Additionally, NUM’s range of servodrives offers various performance levels, providing users with a choice based on their specific requirements. Further information can be found on page 9.

Instruments for Optimization

A comprehensive set of instruments is readily available to facilitate easy commissioning. This includes tools such as the Ball-Bar,

Contour Accuracy, Frequency Analyzer, Oscilloscope, and various others.

Ball-Bar



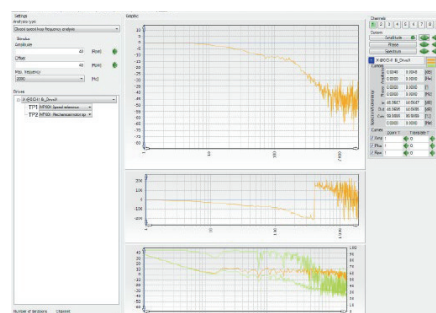
Example of a Ball-Bar trace

The Ball-Bar is instrumental in assessing the behavior of the axes and enables the adjustment of servo drive parameters. Utilizing circles drawn by G02/G03 or small segments (Tabcyls), this function generates a diagram depicting the radial error on the main axes or other axis pairs. This facilitates the adjustment of crucial parameters such as:

- Acceleration anticipation coefficient
- CNC reference filter time constant
- Pitch compensation

Frequency analysis

Frequency analysis is employed to optimize the speed and position control loops of the drives. Various signals can be chosen and displayed as a Bode plot, allowing for the determination



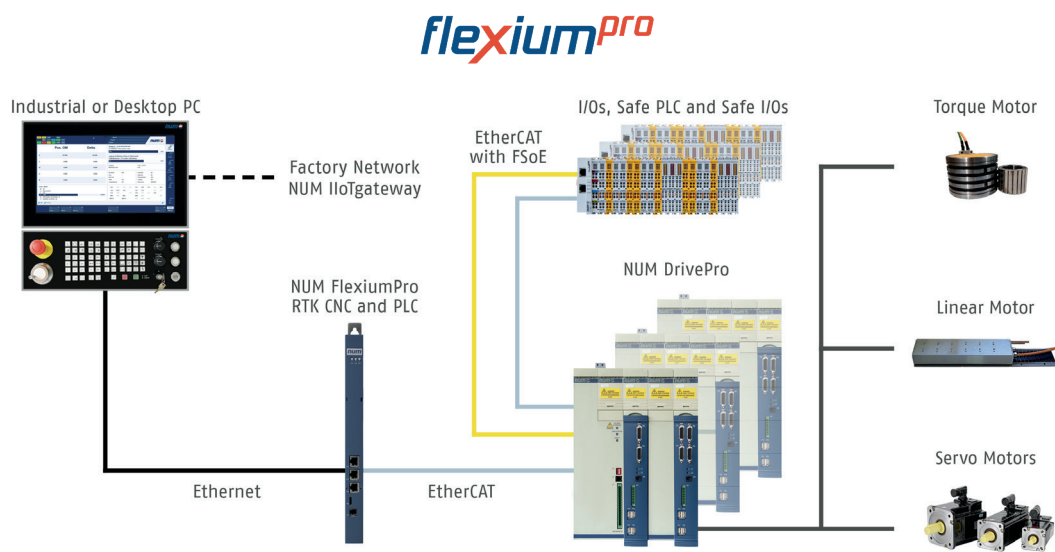
Example of a Frequency analyzer trace.

of regulating quality. This analysis is crucial for detecting unwanted resonances, which can be addressed through mechanical adjustments or the application of a drive filter.

CNC-Systems

Flexibility, Productivity and Safety

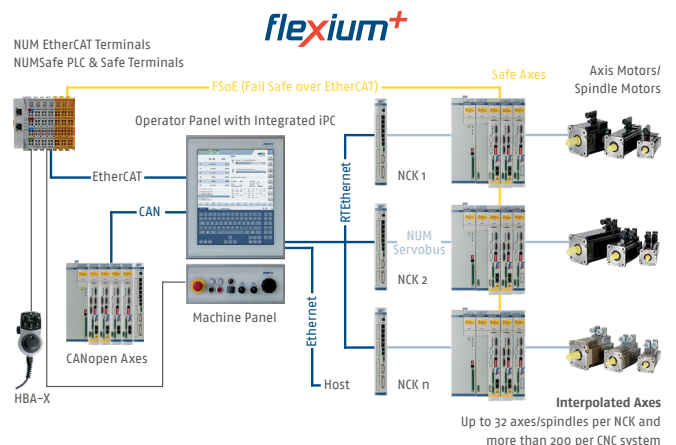
Flexium+ and FlexiumPro – Extreme Scalability



NUM control systems offer remarkable scalability, enabling a precise fit for each specific application. As a result, systems ranging from 1 to more than 200 CNC axes can be effortlessly implemented. In addition to the normal PLC, both the existing Flexium+ and new FlexiumPro systems have a safe PLC which communicates via FSoE (Fail Safe over EtherCAT) with the safe inputs and outputs as well as with the NUMDrive X or NUM DrivePro drive controllers. The systems cover all necessary safety functions in a simple way. The safety logic is programmed with the same software tool as the rest of the PLC. The same tool is also used for all system parameterization and machine commissioning.

The NUMDrive X and NUM DrivePro drive solutions are the result of more than 30 years of experience in the development of fully digital drive systems. The drive amplifiers are available in various versions with different performance data. The wide range of drive amplifiers is available in single-, dual- and quad-axis versions, with different computing power and supports rated currents from a few up to 200 amps. Another strength of the

drive amplifiers is their compactness and high energy efficiency. Our experts will be happy to help you make a technically and financially optimal selection from the wide range of products, in coordination with your application.



NUM Motors

Perfect for all Applications

Excellent volume/performance ratio and great dynamics, so that our motors can satisfy almost all applications.

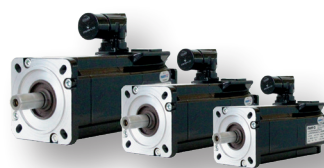
NUM has more than 50 years of experience developing servo and spindle motors. We pioneered the development and production of AC brushless servo motors, as well as synchronous spindle motors with flux weakening.

The comprehensive **servo-motor** series of NUM offer an excellent volume/output ratio, as well as first-class dynamic properties optimized for the machine tool industry. They, with perfect concentric run-out, give great performance even at very low speeds. The so-called "single cable" motors offer the advantage that the complete measuring system cable is eliminated. This simplifies the wiring of the machine significantly and thus saving time and money.

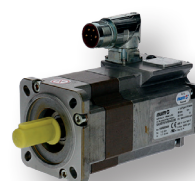
The **asynchronous motors** of the AMS series offer excellent quiet running at low speed, quick and accurate positioning and are ideally suited as a C-axis and for spindle indexing.

The TMX series **torque motors** have an extremely low cogging torque as well as a very high S_1 torque density. They are ideal for applications that require very smooth and precise motion, especially at low speeds. Typical applications are direct drive rotary tables or workhead axes of machine tools.

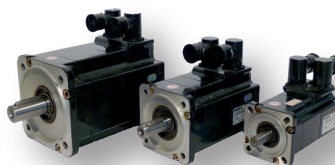
The NUM **LMX linear motors** are specially designed for machine tools. Among other features, they are characterized by a fully enclosed primary, a cooling circuit with large diameters to accommodate fluids with low specific heat capacity, a short pole pitch to increase the force density and reduce temperature, and many other interesting features.



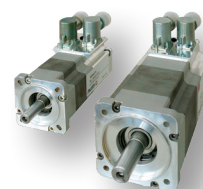
Motors of the series SPX "single cable"



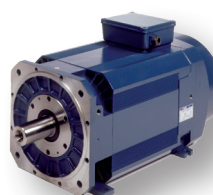
Motors of the series SHX "single cable"



Motors of the BPX series



Motors of the BHX series



Motors of the AMS series



TMX torque motors



LMX linear motors

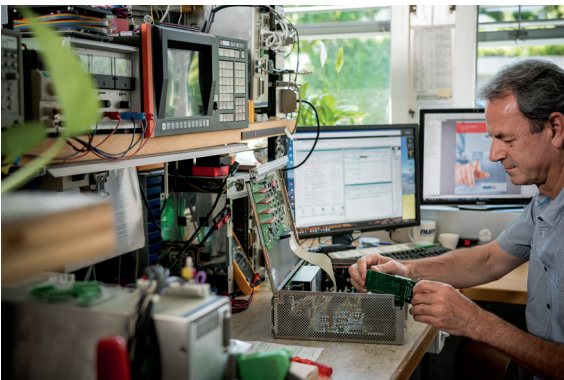
NUM Services

Worldwide at your Service

The decision for NUM is also the decision for a customer service that will support you long after the initial investment as on the first day – even after 20 years and on-site. Our specialists can ensure an extended life for your good (but old) machinery with NUM retrofits.

Worldwide support by experts

For professional analysis and trainings, a perfect infrastructure is available to our experts in all centers of excellence. So that we can assist you quickly and efficiently around the world, we also rely on the advantages of the most modern communication technologies, e.g. for remote maintenance. We can also offer on-site support and consultation services out of our regional branches



Comprehensive training offer

We orient our training to your individual needs – whether its operator training, maintenance, repair and service training, HMI; CNC or PLC programming, or adjustment of servo drives etc.

NUM provides a training offer matched to the customer needs:

- CNC operation
- CNC programming
- PLC programming
- Commissioning and servicing
- Creation of a custom HMI
- Customized customer training

Technically always up to date

Our team of specialists will actively inform you on the latest

hardware- and software developments and provide you with useful technical information.

Repair- and spare parts service

If an error unexpectedly occurs in your CNC system in spite of proper maintenance, you can trust that this will be fixed by dedicated service employees of our global network.



Customer service

For you and your markets, we have a worldwide service organization. The International customer service provides telephone consultation and deployment on site, even for machine installations that are many years old. With a retrofit from NUM, the operating time of an excellent machine can be extended by many years.

Our customer service is available and responsive to help even with cutting edge products and custom developments. We carry local inventory and have your materials and components in stock ready to meet your requirements for quality and delivery times.

Complete CNC Solutions Worldwide



NUM systems and solutions are used worldwide.

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.

NUM has service centers around the world. Visit our website for the current list of locations.

www.num.com



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