num information

JOURNAL FOR CNC–TOTAL SOLUTIONS

num
CNC HighEnd Applications

Editorial
Peter von Rüti, CEO NUM Group

Dear readers,

Industry 4.0 is now on everyone's lips and back on the front pages of many leading trade magazines. It's a topic that stirs both interest and controversy. The concepts and ideas now imaginable with networked technologies seemingly have no limits.

Nevertheless, this is a highly complex subject. While the fourth industrial revolution presents opportunities to enhance productivity, boost efficiency, and opens new realms of possibility, it also carries risks. Not only is operator safety important, but special attention must be given to data protection and IT security. Systems and machines must be protected against unauthorized access and malicious cyberattacks. This presents formidable challenges.

Even with much still in the design phase, at NUM we devote great care to these concerns. As a result, our open systems are already Industry 4.0 compatible – true to our service

motto of "always one step ahead." For further information, please refer to this year's NUMROTO flash No. 20 (available on our website in PDF format) or talk to us personally. Look for us at the EMO Hanover exhibition in September. This year we will again feature a stand at the event where we look forward to meeting with you for a constructive exchange of views and ideas.

We are greatly pleased to inform you about the new NUMgrind package. This is an innovative solution for simplified programming of various tasks on grinding machines, including internal cylindrical grinding, flat grinding and a range of dressing options. The package is equally suited

for new machines as it is for retrofitting your existing plant. The new HMI supplements the range of HMI open technology, such as NUMmill HMI and NUMgear HMI. All HMIs are based on the tool Flexium CAM, which can be used to develop technology-specific HMIs with ease.

As we take our innovations forward, we would like to introduce to you

> **"Our open systems are already Industry 4.0 compatible – true to our service motto of 'always one step ahead'."**
>
> *(Peter von Rüti, CEO NUM Group)*

the fourth generation P1 and P2 industrial PCs plus the FS154i P1 and P2 control panels. These PCs now feature a significantly faster Quad Core processor, a technology under continuous development, all while being coupled with upgraded RAM for an even greater computing speed.

Additionally with the new MP08 for the FS122 control panel, we are now offering a machine control unit of identical width that with an app also doubles as an ISO keyboard. For further information about these products, please turn to the Engineering section in this edition or contact us directly.

I wish you an enjoyable time reading this NUMinformation and look forward to meeting you personally at EMO Hanover.

Peter von Rüti
CEO NUM Group

www.num.com – Did you know...

... that the NUMinformation case studies for the past 10 years can be viewed digitally on our website? You will find these reports under the "References" menu item.

You can scroll through the overview page and open each of the reports as required. Alternatively, there are two filters available at the top that you can use to limit the selection of the reports displayed – one filter for integrated solutions, and one for the type of machine.
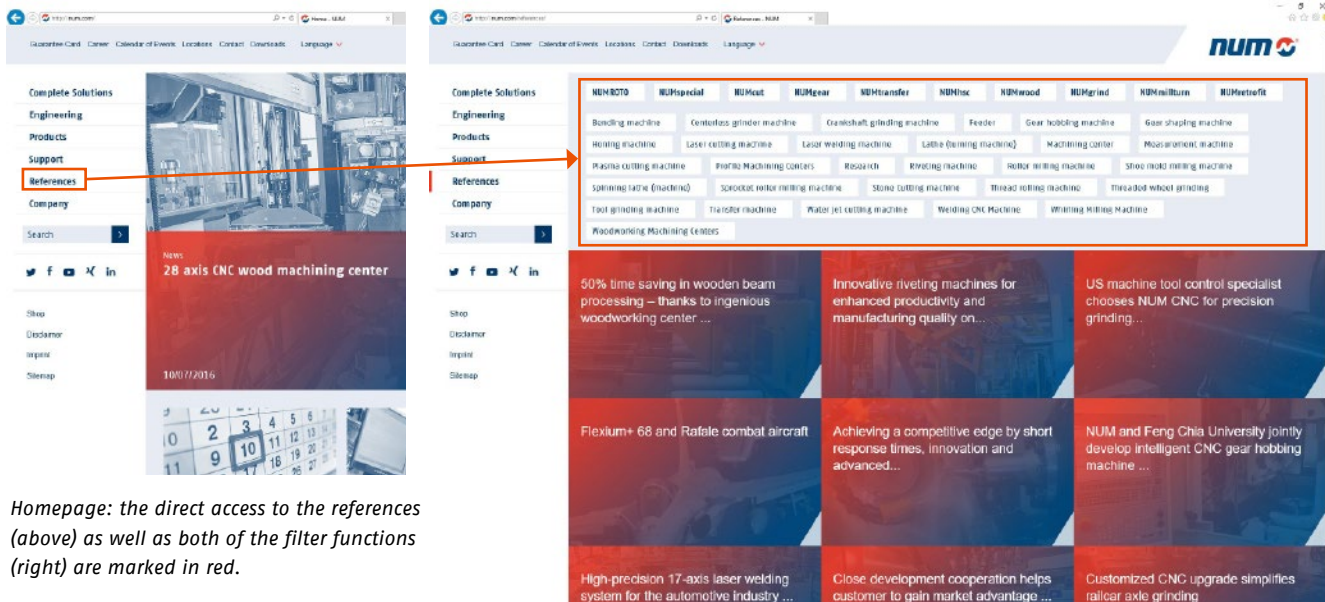
Homepage: the direct access to the references (above) as well as both of the filter functions (right) are marked in red.

And of course, you can still download the NUMinformation as a PDF file under "Downloads".

NUM Event Calendar 2017 / 2018

EMO 2017
September 18–23, in Hanover, Germany
Hall 25, Booth D32

FABTECH 2017
November 6–9, in Chicago, USA
South Building, Booth A3794

FMB 2017
November 8–10, in Bad Salzuflen, Germany
Hall 20, Booth H1

METALEX 2017
November 22–25, in Bangkok, Thailand
Hall 99, Booth AL1701

SPS IPC Drives 2017
November 28–30, in Nuremberg, Germany

GrindTec 2018
March 14–17, in Augsburg, Germany

Events

Innovative graphical software brings
"Shop Floor Programming" simplicity to
CNC precision grinding machines

num ✱
CNC HighEnd Applications

Shop Floor Programming

Innovative new software from NUM enables CNC machine tool builders and retrofitters to provide their customers with exceptionally easy-to-use work piece programming and machine control facilities for precision grinding applications.

Forming the latest application-specific addition to NUM's Flexium CAM suite of CNC software, the new NUMgrind package simplifies machine tool programming for an extensive range of tasks, including external and internal cylindrical grinding, surface grinding, wheel shaping and dressing.

NUMgrind is specifically designed to simplify the creation of G code programs for CNC machine tools through the use of a highly intuitive graphical human machine interface (HMI), conversational-style 'fill in the blanks' type dialogs or a combination of the two. Unlike conventional CAD/CAM workstation tools for generating CNC machine tool control programs, NUMgrind is intended for use in the production environment. It enables shop floor personnel to handle everyday machining tasks such as grinding very quickly and efficiently – and the work can be easily shared amongst several people and several machines.

NUMgrind works in conjunction with embedded CNC grinding and dressing cycles and direct hyperlinks to several production files such as wheel/part data sheets, CAD files and/or other pertinent grinding production data to facilitate efficient manufacturing of a diverse range of workpieces, covering various different wheel forms and part types. It can be configured for a wide variety of machine configurations such as OD/ID Grinders, Surface Grinders, Centerless Grinders, etc.

The cylindrical grinding package includes OD/ID grind cycles for 2-Axis (X/Z) horizontal or vertical grinding machines and also offers an inclined axis capability. The dressing station can be table-mounted or rear-positioned to accommodate a wide range of machines. Standard forms or profiled wheels can be dressed with single point, double point or roller dresser. For surface grinding, NUM offers full grinding cycles for 3-Axis (X/Y/Z) machine configurations with built-in wheel dressing capabilities similar to that of the OD/ID cylindrical grinding package.

A wide range of embedded grinding cycles are included, as shown in table 1.

Machine production time is very efficient due to HMI pages that guide the machine operator through a step-by-step process in setting up the machine for each part. Standard dresser setup and part setup cycles prompt the user to jog the axes to specific locations on the machine in order to teach the dresser and part zero program positions. These cycles enable the user to quickly and easily calibrate their machine for a wide variety of parts and wheels.

As soon as the data entry session is complete, the program is generated automatically, stored, and made ready for execution. The result is a modular, easily modifiable program that will produce the desired grind process.

In conjunction with NUMgrind, Flexium 3D (NUM's graphical simulation software) provides the operator with another very useful tool to further enhance productivity. Once a part program is generated through NUMgrind CAM, the operator can simulate the grinding cycle through Flexium 3D. The software can be configured in a variety of different ways to match many standard cylindrical and surface grinding machines. It can be used directly at the machine or as a standalone program for grinding process verification. This software gives the

operator more power to ensure that the generated programs match their desired outcome before grinding occurs on the machine.

NUM's entire Flexium CAM suite of CNC software, including the new NUMgrind package, is designed for use with the company's latest-generation Flexium+ CNC platform. This platform comprises a fully modular and scalable CNC solution for a wide variety of precision machine tool control applications, and includes a Safe PLC option and comprehensive safe motion control facilities.

According to Steven Schilling, General Manager of NUM Corporation in Naperville, Illinois, "The concept behind Flexium CAM software is to provide a straightforward, easy-to-learn programming method. Our new NUMgrind package includes cycles for a wide variety of cylindrical and surface grinding operations. The OEM or retrofitter receives a control system with a complete, world-class grinding solution built-in, which eliminates the need for any additional software that can take years to develop."

Table 1: NUMgrind includes a wide range of embedded grinding cycles.

NUMgrind Solutions for grinding	GC Cylindrical Grinding Package	GS Surface Grinding Package
Embedded Grinding Cycles		
OD/ID Plunge / Multi-plunge	●	○
OD/ID Plunge with inclined Axes	●	○
OD/ID Oscillating Plunge / Multi-plunge	●	○
OD/ID Cylinder Traverse	●	○
OD/ID Profile Traverse	●	○
OD/ID Taper Traverse	●	○
OD/ID Oscillating Shoulder	●	○
OD/ID Shoulder Traverse	●	○
OD/ID Shoulder Cylinder Blend	●	○
Slot Grind with Continuous Infeed	○	●
Slot Grind with Endpoint Infeed	○	●
Surface Grind with Continuous Infeed	○	●
Surface Grind with Endpoint Infeed	○	●
Auxiliary Grinding Functions		
Wheel Data Management (Eight Stored Setups)	●	●
Straight Wheels	●	●
Special Profile Wheels	●	●
Roller Dresser	●	●
Automatic Wheel Profiling	●	●
Automatic In-process Wheel Dressing	●	●
Automatic Wheel Surface Speed Calculations	●	●
Part and Dresser Setup Routines	●	●
Part Taper "Table Skew" Correction	●	●
Emergency Retract Sequence	●	●
Measurement and Part Origin Modification	●	○
Full cycle support for In-Process Gauging and Gap Elimination	●	○
Run wheel or part profile from CAD system	●	●

● – Standard

○ – Not Available

NUMgrind simplifies machine tool programming for an extensive range of tasks, including external and internal cylindrical grinding, surface grinding, wheel shaping and dressing.

Engineering

FS154i

num ⚡
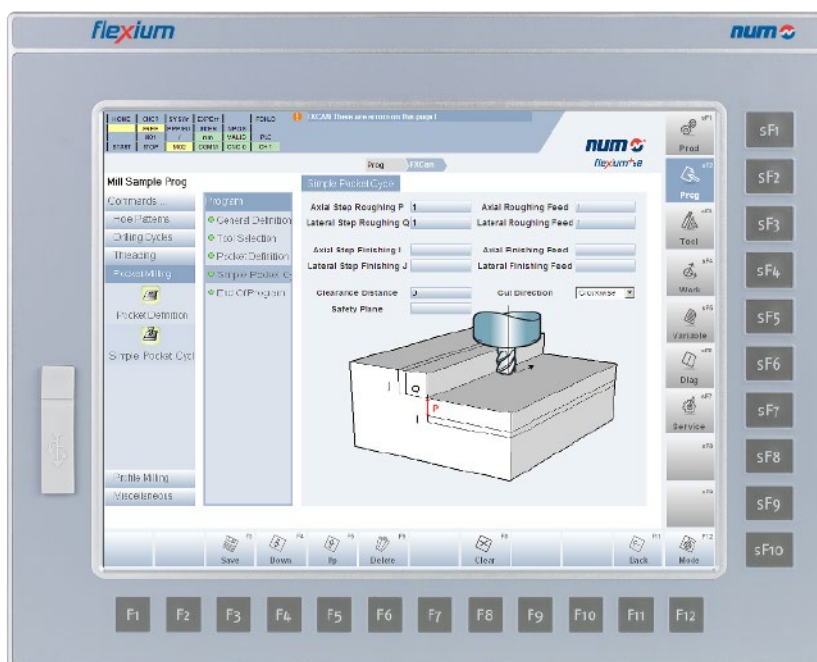**CNC HighEnd Applications**

NUM Flexium PC Hardware Evolutions

NUM now provides its latest generation modern PC which is completely assembled and tested at NUM. The hardware evolution series is divided into NUM Industrial Box PCs P1/P2 G4 and a new range of operator panels called FS154i P1 and P2 which are all based on a much faster quad core processor and innovative motherboard technology.

All new NUM iPCs act as high-performance industrial PCs with real-time extensions suitable for the Flexium RTS target system. The operating system of these new devices is Windows Embedded 8.1 Industry Pro for the P1 series and Windows 10 for the P2 series.

Customer benefits:
- Fast quad core processor technology
- FS154i are more competitive; the list price is identical to FS153i but offers almost twice the performance of the current FS153i panel PC
- FS154 has got the same look and feel as the existing FS153 range
- Bigger mass memory storage device (>250 GB)
- DVI offers various advantages, including quite long distances (50 m)
- FS154 is mechanically compatible with the equivalent FS153
- FS154 allows using a simpler cut-out. Holes for screws are no longer needed. Same solution used as for FS153 and FS122

FS154i

Box PC

	NUM Box PC P1 G4	FS154i P1	NUM Box PC P2 G4	FS154i P2
Panel Coding (x=CAN+NVRAM option)	FXPC004NN1HxR10	FXPC154NF1HxR10 FXPC154NQ1HxR10 FXPC154RF1HxR10 FXPC154RQ1HxR10	FXPC004NN2HxR10	FXPC154NF2HxR10 FXPC154NQ2HxR10 FXPC154RF2HxR10 FXPC154RQ2HxR10
CPU/Board	Intel® Celeron™ CPU J1900 @ 2GHz Quad Core	Intel® Celeron™ CPU J1900 @ 2GHz Quad Core	Intel® i5™ CPU @ 2.3GHz Quad Core	Intel® i5™ CPU @ 2.3GHz Quad Core
Mass Storage	> 250 GB Hard Disk	> 250 GB Hard Disk	> 250 GB Hard Disk	> 250 GB Hard Disk
RAM	2 GB	2 GB	8 GB	8 GB
Operating System	Windows Embedded 8.1 Industry Pro	Windows Embedded 8.1 Industry Pro	Windows 10 IoT Enterprise 64 Bit	Windows 10 IoT Enterprise 64 Bit
Screen	–	Active panel with integrated PC with: – 22 Function Keys – 22 Function Keys and Qwerty Keyboard – Touch Screen (resistive)	–	Active panel with integrated PC with: – 22 Function Keys – 22 Function Keys and Qwerty Keyboard – Touch Screen (resistive)
Ethernet	3 x Gigabit LAN / RTE	3 x Gigabit LAN / RTE	3 x Gigabit LAN / RTE	3 x Gigabit LAN / RTE
Field bus CAN / EtherCAT	Max. 2 / 1	Max. 2 / 1	Max. 2 / 1	Max. 2 / 1
USB external	1 x USB 3.0 3 x USB 2.0	Front: 1 x USB 2.0 Rear: 1 x 3.0 / 3 x 2.0	4 x USB 3.0 2 x USB 2.0	Front: 1 x USB 2.0 Rear: 4 x 3.0 / 1 x 2.0
COM	2	2	2	2
VGA / DVI	0 / 1	0 / 1	0 / 1	0 / 1
Cooling Type	Fan-less	Fan-less	Fan-less	Fan-less
Power supply	24 VDC (+20%/-20%) 1A	24 VDC (+20%/-20%) 1A	24 VDC (+20%/-20%) 1A	24 VDC (+20%/-20%) 1A
Power consumption	Approx. 14 W	Approx. 14 W	Approx. 40 W	Approx. 40 W
Degree of Protection	IP20	IP20	IP20	IP20
Operating temperature range	From 0 – +40 degree C	From 0 – +40 degree C	From 0 – +40 degree C	From 0 – +40 degree C

NUM Flexium Accessories

Customer benefits:
Aside from the MP04, 05 and 06, NUM has started commercialization of a new range of machine panels, called MP08, with a smaller width to fit perfectly to FS122 operating panels. Due to the smaller size, we do not envisage producing versions including the E-Stop button and handwheel. The product is available with either potentiometers or selectors for speed overrides.

This panel is used for manually controlling movements, production initiation and intervention during machining. Using a dedicated software extension, it can also be used as an ISO Code key board.

MP08 includes:
- 60 configurable buttons (real switches) with blue LEDs
- 2 Override potentiometers or selectors for spindle speed and feed rate
- 1 Three-position key switch
- 3 Dedicated buttons (real switches): Reset (white LED), Cycle Stop (Red LED) and Cycle Start (green LED)
- Integrated I/Os: 12 digital inputs and 12 digital outputs
- Connection technology: EtherCAT + wires for safety related devices

Engineering

New Evolutions for Flexium 3D

New Evolutions for Flexium 3D

Evolutions in Flexium 3D

NUMs Flexium 3D simulation has been available for some time and is a strong 3D simulation package that combines work-piece simulation and collision monitoring/detection with other powerful features for offline and online simulation. These capabilities have been extended with two new highly sophisticated modes:

- Flexium 3D Path Editor
- Graphically supported SEARCH mode

Flexium 3D Path Editor

This option is released only for all Flexium+ platforms and allows graphically/text supported path optimization/reworking of digitized or CAD/CAM generated part programs in 6 axes.

The principle of this mode is very fast visualization of the programmed ISO trajectory in the program frame for most interpolation commands (except polynomial interpolation). It can also be used as a simple part program editor with simultaneous graphical path display.

A typical view in a 5-axis part program generates the 3D-path editor main window shown below:
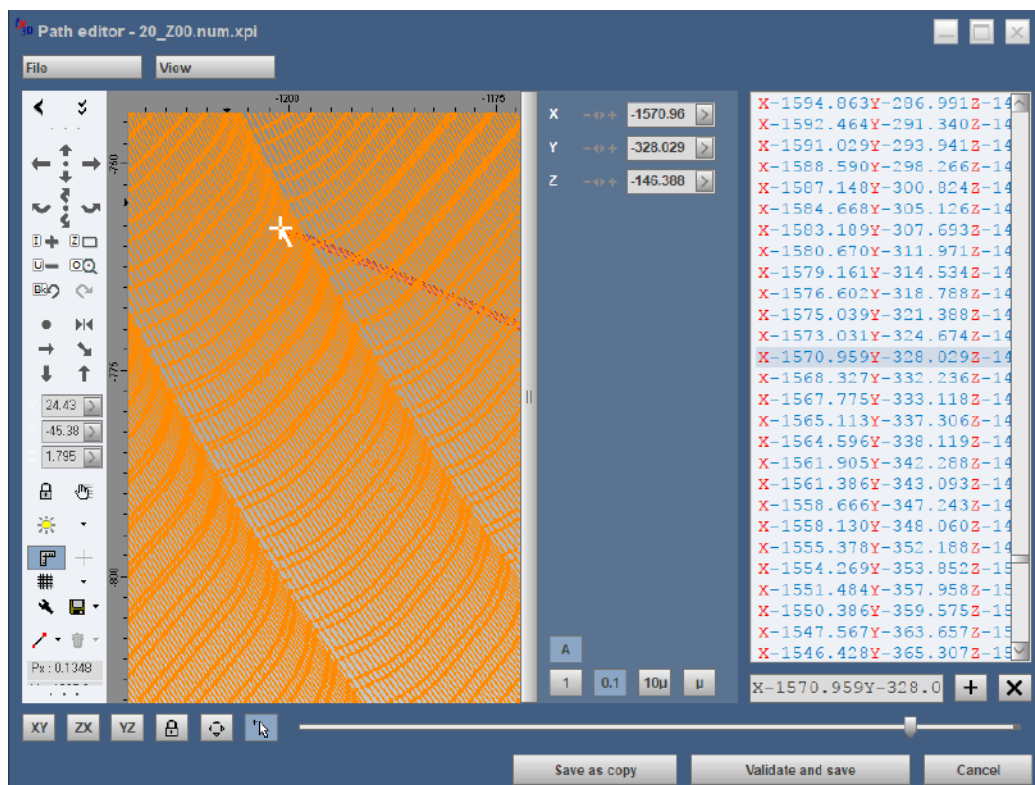
The 3D-path editor main screen is divided into two main windows with different operating controls:
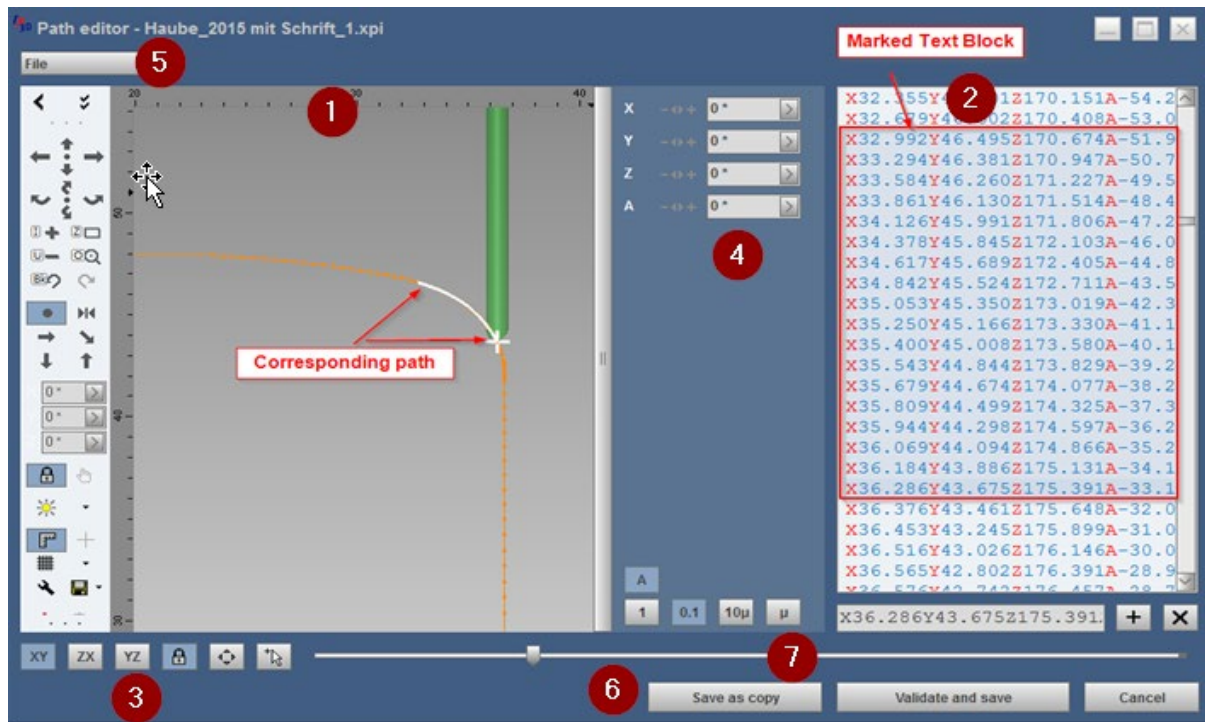
- 3D-path view (**1**): visualization of the complete trajectory of the part program (PP) in default plane view (G17). The white cross highlights the current PP line
- 3D-text view (**2**): the text window of the selected part program with syntax highlighting, dynamic edit command box, command line editor for adding/deleting lines, 'multi-line edit' and visualization of the current PP line
- Plane selection and helpful operation controls (**3**)
- Parameter/value edit box with slider controls (**4**)
- Complete file handling controls (**5**) / (**6**)
- Progress bar (**7**)

Targets and customer benefits are:
- Enables the Flexium 3D Path Editor to be easily used for all milling/turning or cutting applications, and is predestined to perform the optimization direct on the processing machine as pre-process before the series starts
- Based on the detected deviations, the 'contour/path reworking' process permits the machine operator to adapt/correct the contour direct on the machine
- Operation with keyboard & mouse and also touch screen handling are supported
- Point selection/modification either in 3D path view or 3D text view, with simultaneous adjustment of the referenced line or path element
- No part program regeneration in process engineering

Engineering

Graphical supported SEARCH mode
Flexium⁺ SAMX evolutions

Graphical supported SEARCH mode

The integrated, graphically supported block search function, which mainly aimed at waterjet and laser applications was now extended to meet the requirements of milling applications as well. The new graphical environment was realized in Flexium 3D for Flexium⁺ with close interaction inside NCK+ firmware.

The graphically supported block search extends the present variants of SEARCH modes in Flexium⁺:
- Block search with Drip feed mode
- Sequence number search
- String search
- Line number search

Targets and customer benefits are:
- Preview of loaded part program with fast offline simulation of TCP (Tool Center Point) path
- Definition of re-engage position (also within a NC block) with mouse or touch operation
- Specification of different and flexible approach strategies depending on the application
- Execution of a sub-program with programmed movements, machine functions and other NUM ISO-dialect in re-engage process

From this geometrical consideration three variants for the approach path to the TCP trajectory are possible (references are the red approach contours):
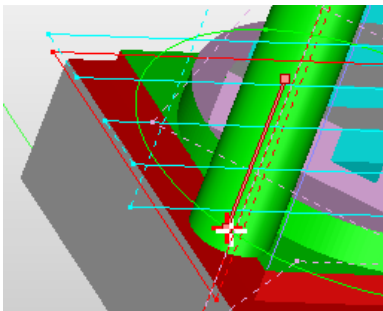
Direct vertical approach to TCP trajectory
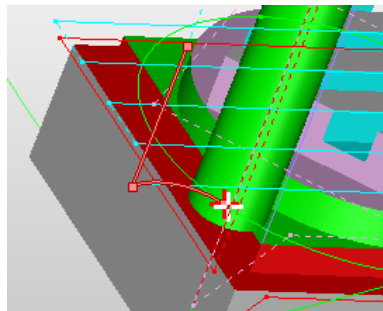
Tangential approach with circular element
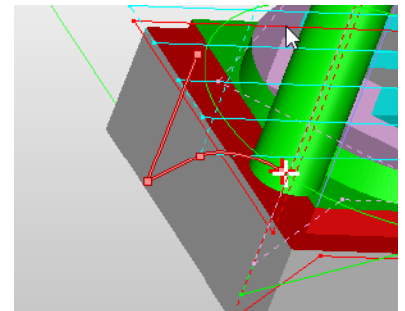
Tangential approach with circular and linear elements

The complete SEARCH-mode process with NCK activities can be implied as follows:
- Define re-engage position with approach contour
- Validate/transmit SEARCH mode command string to NCK
- NC Start
  - Internal block search and calculation of resume position
  - Preparation of axes' movements to beginning of approach contour
  - Execution/transfer of last valid M, S, T, D functions to PLC
- Automatic/manual execution of prepared axes' movements
- Continuous execution of approach contour and proceed part program execution

New SAMX functions

Beside the existing and best practiced safety functions managed by NUM–SAMX:
- **STO** Safe Torque Off
- **SOS** Safe Operational Stop (survey the stop position)
- **SLS** Safely Limited Speed
- **SS1** Safe Stop 1 (end braking with STO)
- **SS2** Safe Stop 2 (end braking with SOS)
- **SLP** Safe limited position (single position pair)
- **SDI** Safe direction

NUM has added an Output function and extended the present SLP function:
- **SCA** Safe Cams
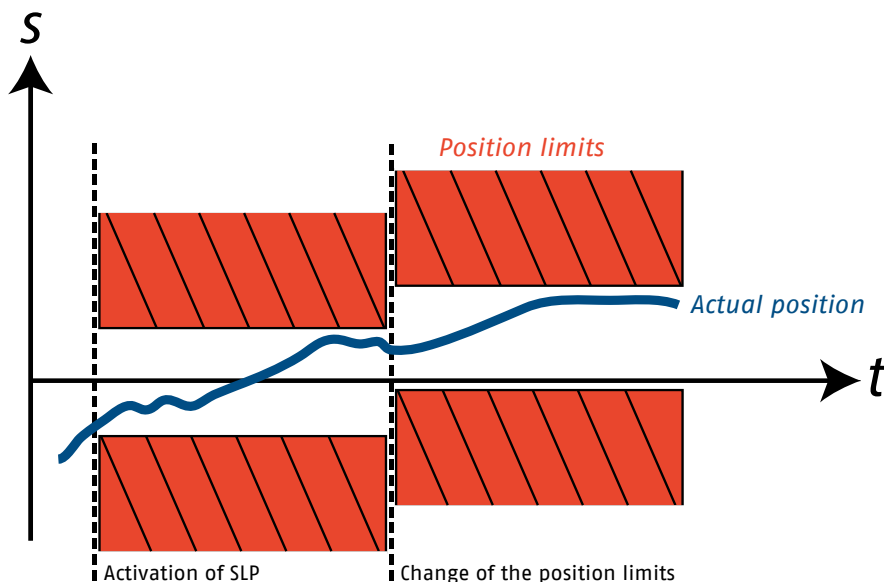- Enlarge the number of **SLP** windows from 1 to 16

Safety function: SLP Windows
In accordance with the SAMX parameter S0025 – S0056, in Flexium Tools you define 16 position limits for the lower/upper boundary in internal units.

Name	Value	Unit	Description	Min	Max	Default
S0024	32768	[]	Absolute sensor resolution by turn (V361)	1	2147483647	32768
S0025	0	[CNC increment]	Position lower limit 1	-2147483...	2147483647	0
S0026	0	[CNC increment]	Position higher limit 1	-2147483...	2147483647	0
S0027	0	[CNC increment]	Position lower limit 2	-2147483...	2147483647	0
S0028	0	[CNC increment]	Position higher limit 2	-2147483...	2147483647	0
S0029	0	[CNC increment]	Position lower limit 3	-2147483...	2147483647	0
S0030	0	[CNC increment]	Position higher limit 3	-2147483...	2147483647	0
S0031	0	[CNC increment]	Position lower limit 4	-2147483...	2147483647	0
S0032	0	[CNC increment]	Position higher limit 4	-2147483...	2147483647	0
S0033	0	[CNC increment]	Position lower limit 5	-2147483...	2147483647	0
S0034	0	[CNC increment]	Position higher limit 5	-2147483648	2147483647	0
S0035	0	[CNC increment]	Position lower limit 6	-2147483...	2147483647	0
S0036	0	[CNC increment]	Position higher limit 6	-2147483...	2147483647	0
S0037	0	[CNC increment]	Position lower limit 7	-2147483...	2147483647	0
S0038	0	[CNC increment]	Position higher limit 7	-2147483...	2147483647	0
S0039	0	[CNC increment]	Position lower limit 8	-2147483...	2147483647	0
S0040	0	[CNC increment]	Position higher limit 8	-2147483...	2147483647	0
S0041	0	[CNC increment]	Position lower limit 9	-2147483...	2147483647	0
S0042	0	[CNC increment]	Position higher limit 9	-2147483...	2147483647	0
S0043	0	[CNC increment]	Position lower limit 10	-2147483...	2147483647	0
S0044	0	[CNC increment]	Position higher limit 10	-2147483...	2147483647	0

SAMX
- SAMX
  - C1 (SamX configuration)
  - C2 (Measures and positions r
  - C3 (Speed loop control)
  - C4 (Sensor configuration)

Color Legend | Alignment | Change PW | Unlock | Export SFTX file | Import SFTX file | Default | Apply | Cancel

Safely-Limited Position (SLP)
The SLP function monitors the axis to ensure that it remains within the permissible traversing range.

Position limits

Actual position

Activation of SLP | Change of the position limits

Engineering

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Safety function: SCA function
The SCA function is always active, once the SAFE homing position has been done and the SLP definition has been made.

- They are based on related SAMX parameters
  - S0008_S0009 for SCA0 (<–SLP 0)
  - S0025_S0026 for SCA1 (<–SLP 1) ...
  - S0053_S0054 for SCA15 (<–SLP 15)
- The SAFE output is TRUE, if the axis position is within the window defined by the couple of safe position
- Any reaction, if the position goes out of the safe position, has to be defined in the Safe PLC

Flexium Tools/PLC Example: assignment of SAMX Inputs to SAMX Outputs and possible visualization:

SamX Inputs	SamX Outputs
Safe Position 0	Safe Position Active
Safe Homing Position	Test Required
Safe Direction +	Safe Homing Done
Safe Direction -	Safe Cam 0
Safe Position 1	Safe Cam 1
Safe Position 2	Safe Cam 2
Safe Position 3	Safe Cam 3
Safe Position 4	Safe Cam 4
Safe Position 5	Safe Cam 5
Safe Position 6	Safe Cam 6
Safe Position 7	Safe Cam 7
Safe Position 8	Safe Cam 8
Safe Position 9	Safe Cam 9
Safe Position 10	Safe Cam 10
Safe Position 11	Safe Cam 11
Safe Position 12	Safe Cam 12
Safe Position 13	Safe Cam 13
Safe Position 14	Safe Cam 14
Safe Position 15	Safe Cam 15

	SCA0 Output	SCA1 Output	SCA2 Output	Safe Homing Done
X	FALSE	FALSE	FALSE	FALSE
X	TRUE	FALSE	FALSE	TRUE
X	TRUE	TRUE	FALSE	TRUE
X	FALSE	TRUE	FALSE	TRUE
X	FALSE	FALSE	FALSE	TRUE
X	FALSE	FALSE	TRUE	TRUE

SCA0 range
SCA1 range
SCA2 range

SCA Safety module diagnostic in Flexium HMI:

Safety module diagnostic

Drive	Safety module status	PWM
DISC NT+ Drive 0	14 - Wait for Ethercat communication	

SAMX Ethercat State	Init
SAMX FSoE Failure reason	Running
SAMX FSoE State	0

SAMX input		SAMX output	
Torque enable	FALSE	standstill	TRUE
nEstop	FALSE	cutting off	TRUE
guard class	FALSE	interlocking out	TRUE
Enable devices	FALSE	Speed	FALSE
Speed limit 1	FALSE	Safe position active	FALSE
Speed limit 2	FALSE	Test rfequired	FALSE
Speed limit 3	FALSE	Safe homing has been done	FALSE
Speed limit 4	FALSE	Safe cam 0	FALSE
Safe position	FALSE	Safe cam 1	FALSE
Safe homing position	FALSE	Safe cam 2	FALSE
Safe direction +	FALSE		FALSE

NUMSmartBackup

The NUMSmartBackup system is a NUM developed tool to backup or restore all Flexium iPCs.

Performance features in detail:
- Bootable stick for disk imaging and cloning
- Compatible with NUM iPCs FS152i P1/P2, FS153i P1/P2, FS192i P2, Box Pcs P1/P2 and further iPCs independent of the concrete installed Windows OS
- Shipped on a 64 GB USB stick (supports USB 2.0 and 3.0)
- Can be used without any monitor, mouse and keyboard (automatically update to/restore from stick only for Box PC P1)
- Backup (=Savedisk)/restore (=Restoredisk) of complete volumes is supported
- Backup/restore supports network drives
- The system is automatically shut down after a successful Backup or Restore

Product label with part number, product name and revision index

Reverse side colored NUM logo on anodized support

NUM Autotuning

NUM has reinvented the autotuning approach for machine's axes and spindles.

Until now, most autotuning procedures consisted of injecting a pre-defined speed/position stimulus, and based on such known stimulus, control loop parameter gains were suggested and tuned. Such procedures were rarely capable of detecting any resonances and of making suitable damping filter recommendations.

NUM proposes a different methodology; the machine's operator just needs to run an ISO part program (almost any part program is acceptable) which moves the axis to be tuned. An automated observer then starts to estimate different physical variables, including total axis inertia, friction in both directions, any vertical loads, and resonances.

Based on these estimates, the NUM autotuning function automatically suggests proportional and integral speed loop gains (suitable for the drive performance and switching frequency in use), a suitable low pass filter, the maximum position loop gain and points out the most critical vibration.

Without any need for a specific speed/position stimulus, NUM autotuning can be used during normal machining and it's also suitable for optimizing axes which are subject to conditional changes. Blanks, for example, often change the inertia of axes considerably – with NUM autotuning, these changes can be identified and control loops adapted accordingly.

NUM autotuning can tune any type of motor: rotary synchronous, rotary asynchronous, linear, torque motors ... including vertical axes, hydraulically balanced axes and spindles.

This new autotuning approach is currently being field validated with plans to make it available as an official NUM tool in 2018.

Engineering

An innovative, precision multi-spindle transfer machine – powered by NUM

Experience, reliability, advanced technology and impeccable after-sales service – these are just some of the benefits that SPADA offers to its customers. SPADA is an Italian manufacturer of machine tools and multi-spindle transfer machines. Embracing the same philosophy as NUM, SPADA is a qualified partner, helping customers to achieve unbeatable competitiveness. Founded in 2009, this young company has 22 employees. The Multi S machine shown on these pages has 33 axes, 25 spindles and runs on 25 channels with 4 NCK. The machine is powered by a NUM Flexium+ 68 CNC system. The special center-focused architecture of the Multi S has numerous advantages, which we will highlight in this article.

The SPADA machines' flexibility and modularity mean their field of use is quite extensive. In terms of the number of machines delivered, the biggest sectors are the automotive and motorcycle industries, manufacturing of hydraulic and pneumatic components, electric motors and power transmission systems. The ISO certified company has so far built over 300 machines of various types, which are used for production purposes in over 16 countries around the globe.

This flexibility is also the most important advantage of the Flexium+ CNC control from NUM, which is used on the SPADA machines. A special customized HMI was developed which focused on ease of use and getting the operators familiarized with the process quickly. Also, the HMI significantly helps the operator change from one production phase to the next, reducing the set-up time and increasing overall productivity. The Multi S machine shown here is very precise – even if the machine is running at high speed to achieve a high workpiece production rate, the quality is also still very high. Even at high speed, the machine has an accuracy of 0.01 mm, a factor that makes the SPADA machine a superb fit in the high precision sectors of industry.

Top right: NTC Italy has developed some unique machine management pages with PLCVisu, supplementing the standard NUM HMI.

Middle right: View of the multi-spindle transfer machine structure, and with panels removed to show technical details.

Bottom right: View of the inside working area of the multi-spindle transfer machine.

Bottom left: From left to right, Mr. Marco Battistotti, Director NUM NTC Italy, Mr. Dario Spada, CEO of SPADA, Mr. Mauro Guerra, President of SPADA and Mr. Emanuele Capitoni, Senior Electronic Engineer.
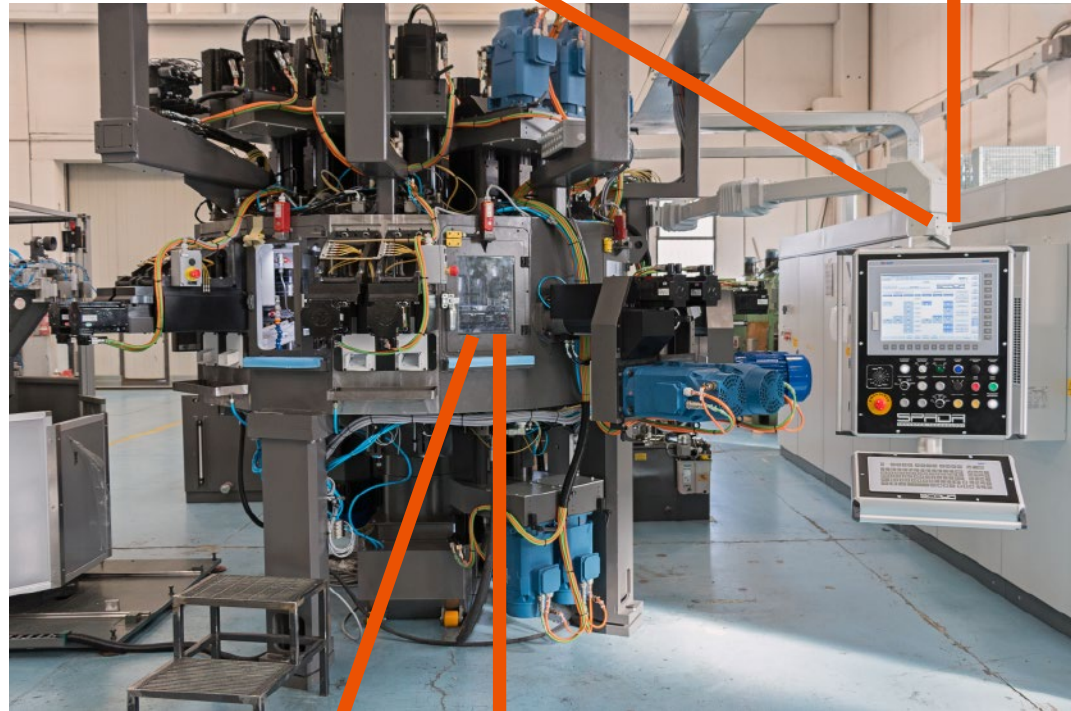
Due to the flexibility of the SPADA machine and the NUM CNC control, the machine settings can be very quickly and easily changed for the production of the next workpiece or component. The machine allows all types of machining, such as milling, drilling, cutting, etc.. Regarding the compact and revolutionary architecture of the Multi S, the distances between the various working stations in the machine are minimized, which helps to significantly reduce the production time of a single workpiece. And as we all know, reducing production time means that a higher quantity of workpieces can be produced in a given time, enabling the owner of the Multi S to obtain the best return on investment.

Another advantage for SPADA's customers is that their machines are very compact, minimizing the floor space required. If you take a look at the architecture, you will notice that the working area is in the center of the machine, like a circle with all axes and spindle motors built around this center, either from above, below or from the side. A quick look highlights many of the advantages of this design. First of all, access to all motors for axes and spindles, as well as other mechanical parts, is very easy. Consequently, the time for which the Multi S stands idle during maintenance is shorter than similar types of machines. Also, all the motors of the axes and spindles – and other mechanical

parts – are outside of the working area. This means that these parts suffer less from water or oil cooling fluids or temperature changes, as they normally do in such machines. But here in the Multi S, these parts stay dry and more or less keep the same temperature throughout the time the machine is in use.

"Since the beginning, cooperation between SPADA and NUM has been very intensive and very good", says Mr. Spada. "The modular NCK architecture helps

SPADA to develop new possibilities for future machines", adds Mr. Battistotti of NUM. By cooperating closely, both SPADA and NUM are able to improve the production quality and quantity for their customers and provide them with a key market advantage.

Precision

Mastering even the most complex workpieces – a revolutionary, 9-axis CNC controlled, weld overlay machine

POLYSOUDE
THE ART OF WELDING

num
CNC HighEnd Applications

TIG weld overlay technology is an advantageous way of meeting the increasing demand for metallurgical bond CRA manifolds and other workpieces. It is of a suitable quality for production systems and for crude oil exploration applications. 100% defect-free CRA deposition, reasonable cost, increased efficiency and high flexibility are the reasons why companies have chosen and are successfully using POLYSOUDE's unique cladding technology, controlled by the Flexium⁺ CNC System from NUM, in their production processes.

Just as NUM is known as being a reliable partner when it comes to specialized and customized CNC automation, POLYSOUDE is a reliable partner when it comes to automated welding and cladding. POLYSOUDE is renowned for its expertise in orbital TIG welding, with an extensive product range which includes highly efficient equipment for mechanized, automated, robotic and automatic welding systems, as well as solutions for weld overlay applications. Through close cooperation, POLYSOUDE and NUM have developed the 9-axis CNC controlled weld overlay machine shown on these pages, which is one of the most precise systems available on the market today.

Installations designed for cladding in a vertical position are usually dedicated to performing cladding operations on cylindrical parts. In most cases the workpieces are positioned on a turntable or positioner. However, there are other, much more complex scenarios, where it is impossible to set the workpieces in motion, either due to their size and weight, or quite simply because of their geometry (e.g. eccentric bore holes or nozzles). A group of endlessly rotating collector welding and cladding heads, with torches which can be rotated without twisting the cable/hose bundles, has been specifically designed for such situations. These machines handle cladding operations on fixed workpieces with a high level of automation.

The automation of this machine is controlled by a Flexium⁺ 68 CNC from NUM. Eight of the nine axes are equipped with powerful single-cable motors and Safe PLC. Operation of the machine is achieved either via a NUM nPad with a personalized GUI (Graphical User Interface) for welding operations, or via a NUM FS152i machine panel with an additional 12" display, also utilizing a personalized GUI. Even more complex workpiece geometries – such as manifolds with intersections or cross sections – 'bore to bore' functions, supported by the NUM CNC system and the personalized POLYSOUDE GUI.

But what exactly is weld overlay – and what is it good for? Cladding is a welding procedure that deposits a wire filler metal on the surface of the workpiece, as opposed to joining two pieces of material. Generally this is used for corrosion resistance or wear resistance and frequently a different material is used for the clad than for the base metal. Orbital cladding can be done by orbital pipe weld heads using cold wire. In some cases, hot wire technol-

Bottom left: from left to right, Mr. Hans-Peter Mariner, CEO POLYSOUDE, Mr. Elia Barsanti, Director NUM France, Mr. Jean-Pierre Barthoux, Director of Engineering, POLYSOUDE and Mr. Christian Herblot, Application Engineer, NUM France.
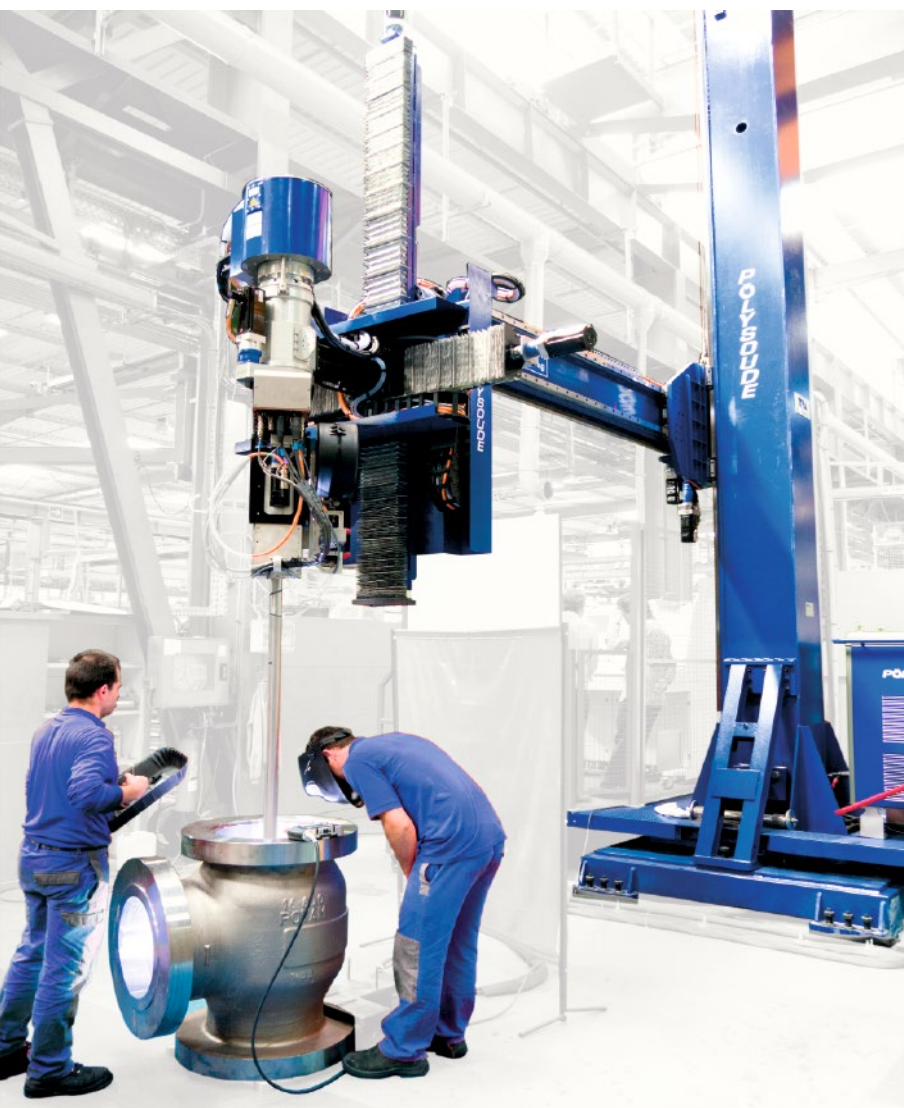
Bottom right: employees working with the revolutionary, 9 axes CNC controlled weld overlay machine.

Middle right: view of the FS152i panel with an additional 12" display and below the nPad, all 3 with personalized GUI.

Top right: workpiece after and during the weld overlay process.

ogy can be used. In hot wire welding, a power supply controls the heat of the filler wire almost to its melting point prior to its introduction into the weld puddle. Arc energy that would usually go into melting the wire provides more penetration and increases deposition beyond what is possible with standard cold wire TIG. In cladding applications the hot wire solution can result in weld deposition that approaches MIG speed, but with TIG quality.

The Hot Wire TIG welding process is a benchmark in the area of automation for high-quality coating or buttering operations. There is no question of replacing other processes where such a choice is appropriate, but this technique should be considered where the shape to be cladded is complex, where space constraints are severe or quite simply where a higher level of automation is desirable. At POLYSOUDE, a range of standard equipment and several specific solutions are available to cover the diversity of applications.

Like NUM, POLYSOUDE has been in business for over 50 years, during which time it has expanded its operations throughout the world. POLYSOUDE has about 250 employees, making it about the same size as NUM. With its own 13 subsidiaries, which provide a combination of sales and services, POLYSOUDE is close to its customers worldwide. And also just like NUM, POLYSOUDE has built up a relationship with its customers and partners based on trust. "Our strength lies in our collaborative approach, backed up by specialists like NUM, working in synergy and adopting a "Zero Risk / Zero Defects" approach in dealing with customers", says Mr. Hans-Peter Mariner, CEO of POLYSOUDE. The company is always at the cutting edge of R&D; its experts' combination of experience and innovation has led to it being acknowledged as a trailblazer in its field. "The 9-axis CNC controlled weld overlay machine is the result of close cooperation between POLYSOUDE and NUM", adds Mr. Elia Barsanti, Director of NUM France.

Revolutionary

Custom-made coated tools within 5 days – no problem for INOVATOOLS thanks to the power of NUMROTO

With the express offering of 'production of custom tools within 5 days', INOVATOOLS distinguishes itself from all the other tool grinders with a unique feature: within one working week, INOVATOOLS is able to deliver custom-made tools tailored to the individual requirements of the customer, including the coating. This includes special solid carbide cutters and drills with dimensions between 0.1 mm and 32 mm. In addition to custom-made tools, INOVATOOLS also develops and manufactures standard tools in batches as well as high-precision parts for mechanical engineering. The tools are used around the world by customers from a wide variety of industries, such as mechanical engineering, aeronautical engineering and the automotive industry as well as in the tool and mold making sector. There, these high-quality tools from INOVATOOLS contribute to effective business solutions for their customers.

FIGHTMAX – the solid carbide HPC milling cutter

With FIGHTMAX, INOVATOOLS is sending a well-trained HPC fighter into the ring. This powerful tool is especially useful when processing steel and hardly shows any signs of wear, even when used for longer time periods, while its endurance capacity is equally impressive. The solid carbide HPC milling cutter consists of tough micrograin carbide, which is able to successfully deal with the difficult loads that the tool is confronted with. The h5-quality shaft design with 0.005 mm rotation accuracy ensures quiet and vibration-free usage. The highly unequally split and unequally twisted geometry of the 4-edged tool in combination with reinforced cutting edges contribute to its vibration-free operation and enables high feed rates, even at high cutting depths. The large groove cross-sections with ultra-smooth finishings ensure optimum chip flow away from the contact zone. The special VAROCON PLUS smooth coating not only supports the quick removal of the splinters, but also makes the FIGHTMAX resistant to wear and extreme temperatures. The FIGHTMAX is available in a short and a long version in diameter ranges between 6 mm and 20 mm.

For over 25 years, INOVATOOLS (Eckerle & Ertel GmbH), in the heart of Bavaria, has been known for providing the very best quality and service. Practically from the beginning, with the first purchase of CNC tool grinders with NUMROTO, INOVATOOLS has been working with NUM. In the meantime, the number of CNC machines in INOVATOOLS's factory has increased to more than 90, most of which are equipped with NUMROTO. With their headquarters in Kinding/Haun Stetten and four other production facilities in Weimar, Austria, Portugal and Turkey, INOVATOOLS is relatively close to customers and

Above: the new INOVATOOLS solid carbide HPC milling cutter, FIGHTMAX, with special enhanced durability and tenacity for the processing of steel.

Top right: f.l.t.r. Mr. Jörg Federer, Head of Application Technology NUMROTO, Mr. Jochen Eckerle, Head of Production at INOVATOOLS and Mr. Dennis Marz, Development Manager at INOVATOOLS.

Bottom left: INOVATOOLS uses tool grinding machines, equipped with NUMROTO, from various manufacturers.

Bottom right: drills and Cutters ready for delivery. INOVATOOLS has a production output of 30,000 tools per week.

ideally located from a logistics point of view. In these locations, INOVA-TOOLS is able to provide comprehensive service to their customers as well as on-site at the customer. A global sales network with offices in various countries is available for customers in Europe and Asia.

INOVATOOLS and NUMROTO are well aware that the demands of customers and markets are constantly changing. Because of its experience in various industries and close cooperation with partners such as NUM, INOVATOOLS is able to give customers a key advantage in a very competitive market. For this reason, INOVATOOLS put its first coating plant into operation in 2002, and has subsequently acquired the ability to be involved in the entire value chain of the precision tool manufacturing process.

More than 200 employees produce over 2 million tools for customers annually. One of the "in-house" specialties of INOVATOOLS is the production of complex custom-made tools with the NUMROTO form-cutter software. In this regard, INOVATOOLS offers a unique express service of 5 days. This means that INOVATOOLS can manufacture and apply a coating to a custom-made tool within 5

days of the customer's request. This is a very impressive and unique service in the industry.

"Our in-house specialists are trained continually. NUMROTO is a very flexible software package that helps us a lot in this regard. Once an employee has been trained, they are able to operate, by means of the multi-user operating system, every machine that runs NUMROTO", says Mr. Jochen

Eckerle, who also adds: "The master programs were created here in Kinding and subsequently adopted and used by the local branch offices in the production process". "A lot of time can be saved by means of this process and a seamless data backup process has also been established", Mr. Federer concludes.

High-Precision

Smart 5 axis CNC woodworking center – perfect for a wide variety of processing steps

Pouwels sprl is a small, flexible machine builder based in Belgium, which specializes in the manufacture of routers for all processing steps, featuring manual operation, semi-automatic and CNC control. These machines are very helpful in the woodworking industry, for manufacturers of staircases, windows, doors, etc., thanks to their quality, precision, ease of use and time- and labor-saving capabilities. Pouwels' machines are used by many manufacturers throughout Europe and in the USA. The CNC controlled versions of the machines are especially popular. Pouwels is committed to the manufacture of robust machines for the woodworking industry, backed by excellent technical service and the proven ability of listening to its customers.

Founded in 1993, Pouwels is located in the east of Belgium, close to the city of Liège and the German border. It is a small, international company and like NUM, provides a 'full service' offering, with 12 employees. "The size of the company is perfect to be flexible for the customer and to adapt rapidly to changes on the market", says Mr. Didier Pouwels, owner and chief engineer of Pouwels sprl. Pouwels has developed and built CNC machines for the woodworking market for the past 20 or so years. Since the beginning, NUM has been the CNC partner of choice for Pouwels, and the cooperation of the two companies has grown steadily throughout this time.

Like NUM, Pouwels also focuses on providing total solutions to accompany the customer through the entire lifetime of a machine. This means, in the case of the 5 Axis CNC machine shown here, which they have developed and constructed entirely by themselves, Pouwels is also the main partner and contact for the customer, providing support and service, as well as CNC control and laser adjustment components. By remote maintenance via Internet, Pouwels is able to react quickly and efficiently to the customer's needs and solve the majorities of problems online.

The 5 axis woodworking center shown on this page is controlled by a NUM Flexium$^+$ CNC. In addition to the 5 axes, the CNC system also controls a second working head, which is equipped with a diverse assortment of tools for woodworking and a tool changer. This CNC machine is specially designed for machining solid wood. Thanks to its up to date technology and the user-friendly HMI designed by Pouwels, the machine provides the user with a very convenient, simple and highly productive means of performing a wide variety of woodworking processes. The machining width of this machine is 1,500 mm with a machining length of 6,000 mm, and it has an exceptional height capability of 650 mm on the Z axis, with a spindle power of 15 kW. This machine is ideally suited to perform both simple and complex machining requirements. Like NUM, Pouwels builds total solutions for it's customers, providing them with the best possible value.

CNC drilling and sawing processing center for steel beams and profiles

For Adunguem, as for NUM, it is essential that our equipment provides a quick and efficient solution which is adapted to the needs of both, customers and partners. Adunguem's M&G Steel Machine brand presents a complete solution that meets all of these needs, functionally designed for each client. Adunguem is also focused to providing it's customers with extremely responsive service and support through the total machine life cycle. A key element and essential cornerstone critical in the development of enterprises. Adunguem's intensions are to be at the forefront with regard to creating equipment for the metal industry – using the latest technology and in line with new developments in the market.

Registered and approved as a national brand, M&G Steel Machines presents the unique equipment, designed and manufactured in Paços de Ferreira, Portugal. The machine shown here is the only beam and profile processing center produced in Portugal.

This steel processing center has a system for drilling, threading, marking and other operations of profiles with three heads and a CNC system, powered by a NUM Flexium CNC unit. This is an ideal processing center for steel stockholders and structural steel builders with large production outputs and requiring very versatile machining capabilities. The high accuracy of the pusher is reached by moving it by a servo motor with integrated measuring system. This product line provides three heads for drilling up to 40 mm in diameter. HSS drill bits can be used as well as hard metal bits which enable drilling at greater speeds.

Equipped with the NUM Flexium CNC system's touch screen, which operates under the Windows environment, the machine's operation is very intuitive, which dramatically reduces the user's learning curve. It is fully compatible with all the major CAD/CAM systems on the market, as well as DSTV files. The conveyer elements accommodates 250 mm rolls and has a short distance between them, in order to stabilize and better direct the bar. This system prevents the materials colliding with the structure of the store at the time of movement.

The machine's innovative design allows attractively reduced dimensions, reduces handling time and consequently enhances global processing speed.
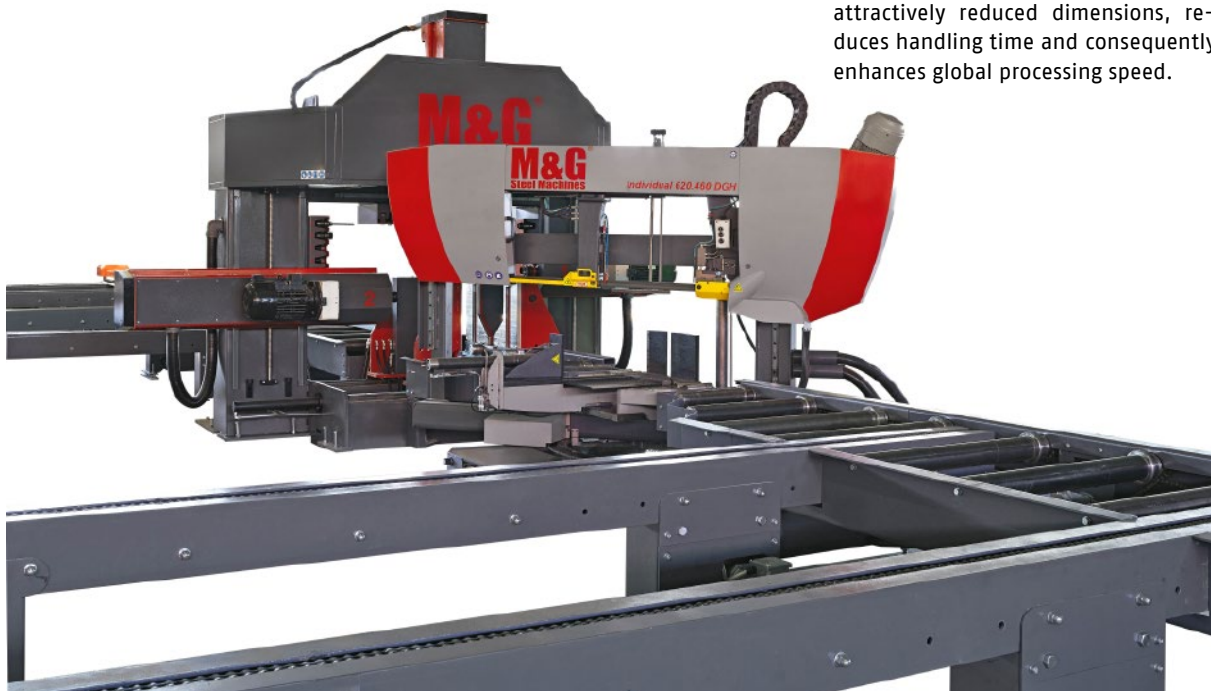
Precision wood machining centre uses 28-axis CNC system from NUM

When it comes to the highest level of precision in engineering wood construction, the name of Krüsi has been a mainstay over the past 50 years. Paired with a CNC controller from NUM, Krüsi Maschinenbau AG located in the beautiful Appenzell region now offers a CNC woodworking machine of superlative quality. The MC15 CNC wood machining center comes with up to 28 axes and a maximum of 6 machining heads, each of which can be fitted with 4 machine tools. Wooden bars with dimensions from 65 cm wide and 30 cm high, and with a variable length of up to 1200 cm and a weight of up to 1.5 tons can be machined easily and quickly from all sides.
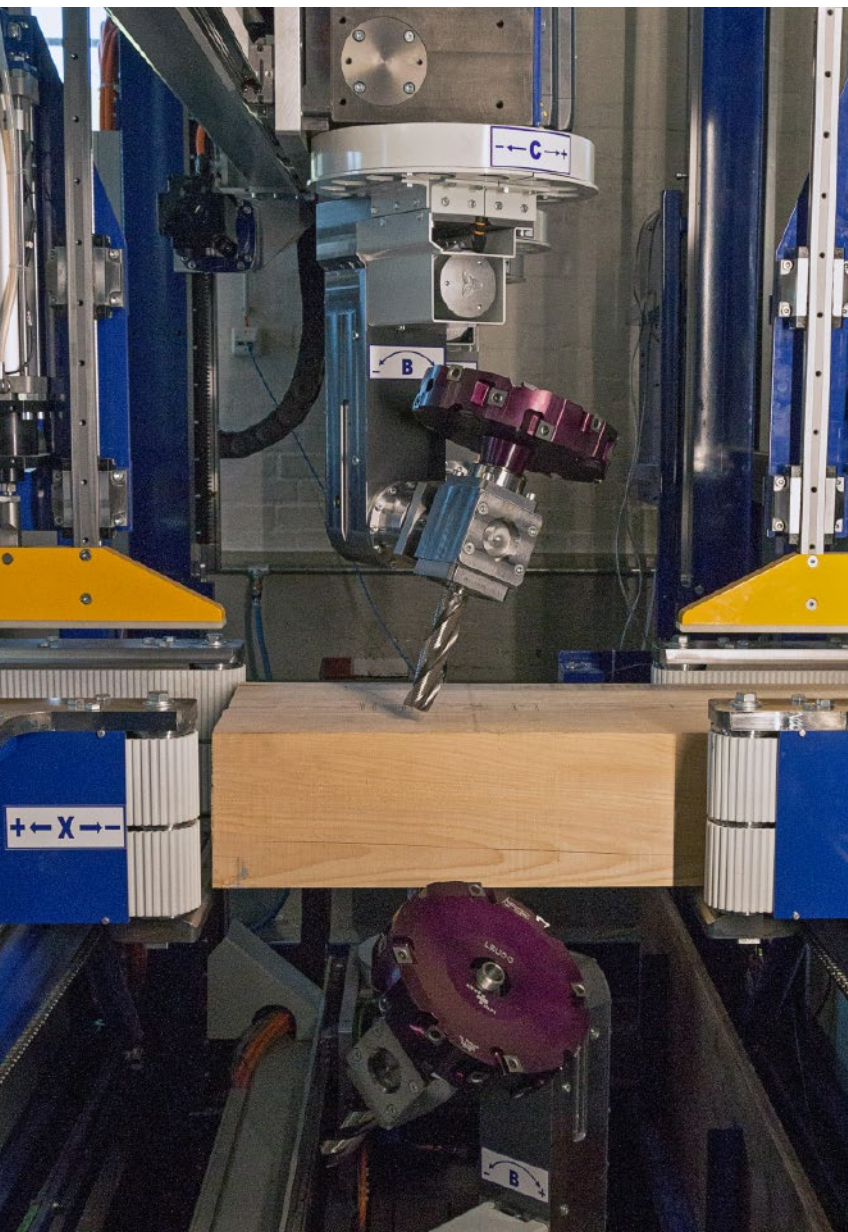
It would not have been possible to build visionary wooden structures such as Metz' Center Pompidou in France, the Tamedia building in Zurich or the Nine Bridges golf club in South Korea without Krüsi CNC machines. Such structures consist of several hundreds of individual parts where it is rare occurrence that any one piece is like another. The precision systems from Krüsi process all wooden elements, regardless of how complex or delicate the construction is.

Krüsi Maschinenbau AG employs a workforce of about 20 and, like NUM, is an internationally operating Swiss company with its registered office in Schönengrund in the Appenzeller region – just a few kilometers away from NUM's company headquarters. Apart from high-tech systems for free-form beams, the company's range of products includes longitudinal circular saws, chalet construction machinery and trimming machines.

The initial cooperation between NUM AG and Krüsi Maschinenbau AG took place in the middle of the 80's. At that time, the first fully automatic CNC-controlled trimming machine in the world was successfully brought to market. The new MC15 CNC wood machining center, redesigned from the ground up, has been developed jointly as the result of close cooperation between Krüsi and NUM. The highly modern CNC wood machining center enables workpieces of all kinds to be sawed, milled, planed, chamfered, beaded, drilled and grooved from all sides. The MC15 is suitable for all work pertaining to modern and conventional wood construction engineering, which demands stringent quality and precision.

The MC15 is modular in design, i.e. the number of machining heads and even the dimensions of the loading and unloading station can be adapted as required. The current MC15 is itself built on a gigantic scale in order to machine the aforementioned wooden bars at the maxi-

Bottom left: A look into the core of the CNC-controlled wood machining machine with a view of the machining heads above and below the workpiece.

Top right: NUM CNC controller operator unit with 19 touch-screens (top left). The routing of the workpiece through the wood machining center (bottom left). In front of the Krüsi CNC wood machining center are (from right to left), Mr. Urs Iseli, CEO of Krüsi Maschinenbau AG, Mr. Kurt Plüss, NUM Sales and Mr. Konrad Näscher, application Engineer at NUM.

Bottom right: Top view of the CNC wood machining center of Krüsi Maschinenbau, equipped with a NUM CNC controller.

mum dimensions of 30 x 60 x 1200 cm. With a length of 28 m, a width of 3 m, and a height of 3 m above the ground and 1 m depth below the floor, the modern CNC wood machining center cannot be overlooked. In order to move the heavy wooden bars weighing up to 1.5 tons, the X-axis has four motors, two on each side of the rough beam. These are controlled independently. However, in most cases they are used synchronously. The 6 machining heads are each moved laterally on the Y-axis, each having its own motor. They are mounted on two portals, one above and one below the workpiece. The portals are positioned at the height of two Z axes with 2 motors each. The 6 machining heads, each of which is provided with a spindle, can be fitted with up to 4 tools per head. Alternately, 2 machining heads can continuously machine the wooden bar, one from below and the other from above.

The 28 axes are controlled with the help of a NUM Flexium$^+$ CNC controller. Apart from the integrated safety controller, the CNC wood machining center has NUMDrive X drives to control the axes and SHX single cable motors to drive the axes, as well as an FS192LS touch-sensitive screen to control the machine. All these components come from NUM, since this is the only way that proper and precise start to finish machine operation can be ensured.

This newly designed CNC wood-machining center has already awakened the interest of a number of customers and orders for several machines have already been received. At the industrial Trade Fair for wood in Basel, Holz in 2016, the MC15 was showcased for the first time to a wide audience. A larger machine on which wider wooden bars can be machined is already in the planning phase. This is always done in order to give customers a competitive edge in an increasingly tough market.

CNC Precision

Heavy-duty underfloor wheel lathe – flexible and secure, controlled by a NUM CNC

With innovative ideas, secure and dependable technology and NUM as a reliable partner, PMC-Colinet conquers new industrial sectors. Who at the outset could have imagined the international success of the merger between the American company PMC Industries, founded in 1912 in north-east Cleveland, USA, and the Belgian company M.P. Colinet founded in Le Roeulx, Belgium? Since their integration into a group as prestigious as Park Ohio in 1999, PMC-Colinet has been a dominant player in a market where globalization and the oil crisis change the state of play on a daily basis.

PMC-Colinet continuously meets the challenges of productivity and specialization. Like NUM's CNC systems, machines bearing the PMC-Colinet trademark are some of the most productive and longest-lived on the market today. When the oil market started to stagnate some years ago, PMC-Colinet began developing machines for other industrial sectors, with a particular focus on the railway industry. The national French railway company SNCF was in need of heavy-duty wheel lathe machines, to maintain their railway engines and wagons. As PMC-Colinet is well known in the rotating tool industry, SNCF asked the company to investigate the feasibility of a heavy-duty wheel lathe machine. Close cooperation between PMC-Colinet, NUM and SNCF has resulted in the development and realization of the heavy-duty underfloor wheel lathe machine shown below. Production of two more machines of this type is currently under negotiation.

Like NUM, PMC-Colinet works closely to meet customers' needs. Manufacturing, R&D and marketing are performed at both its USA and Belgium locations, enabling the company to respond quickly and effectively anywhere in the world if needed.

To understand the success of PMC-Colinet, we must credit the merger of these two formerly private companies and their integration into Park Ohio Corporation. When Park Ohio, an American holding company, was looking to increase its presence in the OCTG (Oil Country Tubular Goods) market, it first acquired PMC Industries, an Ohio-based, specialty machine tool builder with 80+ years in the OCTG business. MP Colinet, a Belgian lathe builder founded in 1921, was PMC's main competitor and was also acquired by Park Ohio within months of the PMC acquisition. The merger of PMC and Colinet combines the expertise of the American and Belgian entities into one company that offers tool and product rotating technologies to OCTG customers around the world. Implemented in 1999, this merger encouraged PMC-Colinet's ambitious growth, backed by the strength of its new owner.

A key advantage for PMC-Colinet is that NUM has collaborated with SNCF for many years, working on a number of highly successful projects. In addition, NUM already has experience of developing and implementing underfloor wheel lathe machines – a few years back the company, together with a partner, realized such a machine for the trams of the municipal transport services of the city of Zurich. These experiences and the expertise gained were useful to build up the new, advanced wheel lathe machine constructed by PMC-Colinet for SNCF and their railroad engines and wagons.
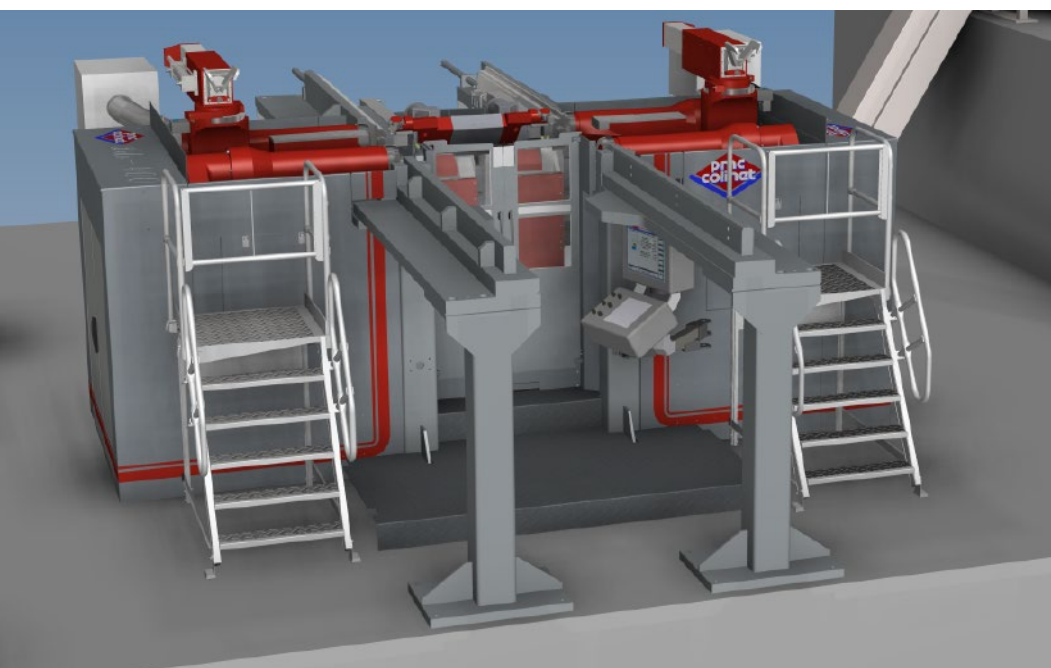
Left: CAD model of the heavy-duty wheel lathe machine.

Top right: The heavy-duty wheel lathe machine in the final phase of construction with a ferry axle on the worktable.

Middle right: the railway vehicle wheel rests between two drive rollers and is worked with the tools shown in the photo.

Bottom right: from left to right. Mr. Emmanuël Murer, Head of the Engineering Department of the Belgian Unit of PMC-Colinet, Mr. Philippe Gosset, Electric Engineer of the Belgian Unit of PMC-Colinet and Mr. Jean-François Hermann, Sales Engineer of NUM.

The machine is constructed underfloor, which means that the train engine or wagon can role on to it easily, directly from the railroad tracks. It has adjustable gauge widths and is therefore able to handle trains with gauge widths from 1000 mm up to 1,676 mm. The size of the train wheels' outside diameter can vary from 500 mm up to 1,600 mm and the maximum weight per train axle (wheel set) is up to 40 tons.

An entire series of wheel sets can be machined regardless of whether they have external or internal bearing boxes – and it also does not matter if they are mechanically connected, or if they are with or without brake discs. Like the wheels, a series of brake discs can be machined – whether they are monolithic or sectored discs fixed on the shaft, or monolithic or sectored discs flanged on the inside or on the outside of the wheel. The weight of this sizable machine is between 25 and 27 tons, dependent on selected options.

The machine is controlled by a CNC system from NUM's Flexium platform, using NUMDrive C drives and a specially developed 4 axis synchronization facility (2 stations, each with 2 synchronized axis motors per wheel or 4 synchronized axis motors per train axle). PMC-Colinet has developed a special HMI, running within the Flexium system, making the operation of the machine easy and self-explanatory.

"The advantages of NUM CNC include the stability of the system and the easy control handling", says Mr. Emmanuël Murer, Head of the Engineering Department of the Belgian Unit. In the future, PMC-Colinet intends building all CNC machines in this field with a NUM control system. Of course, the final customers have the last word regarding what kind of CNC control gets mounted on their machines, but the success, the flexibility, the connectivity and the simplicity of using a NUM control system should certainly make the decision easier.

synchronized

Flexium⁺ is CNC platform of choice
for machine retrofitter

The applications flexibility of NUM's latest-generation Flexium⁺ CNC platform is proving to be a real boon for machine tool engineering company Euro CNC Ltd. Based in Bromyard, UK, Euro CNC specializes in retrofitting, rebuilding and upgrading machine tools. This often involves equipping manual machines with full or partial CNC systems.

According to Tim Clarke, Director of Euro CNC, "Having cooperated with NUM for some six years now, we have gained considerable experience with their CNC products and use NUM for nearly all of our machine retrofit projects. We are also about to ramp up production of an entirely new type of gear shaper machine, which is based on NUM's Flexium⁺ CNC platform. The flexibility of this latest-generation CNC system and its supporting software is second to none, which is helping us to simplify design and development, and to reduce the build time of complex multi-axis machines."

Euro CNC works closely with NUM's UK facility, but it also receives technical support in gear hobbing, grinding and shaping applications direct from headquarter and NUM USA, which have extensive expertise in these application areas. To date, most of Euro CNC's retrofit projects have involved gear hobbing machines, for which the company has elected to use NUM's Flexium CNC systems, digital motors and drives.

As Tim Clarke explains, "One of the benefits of standardizing on NUM is that we are able to utilize their renowned NUMgear software for most of our machine retrofit projects. This employs a conversational style control approach, which our customers find very easy to use – it enables their machine operators to create hobbing cycles without the need for special CNC programming skills. Our close working relationship with NUM's headquarter and US facility also means that we are able to respond to requests for application-specific enhancements to this software very quickly – and of course, we additionally benefit from excellent technical support from their UK facility. To date, we have installed NUMgear on about 30 gear hobbing machines,

and have received excellent feedback from our customers."

In collaboration with NUM, Euro CNC recently rebuilt a six axis plus spindle gear hobbing machine using the Flexium⁺ CNC platform. Based on a high-end Flexium⁺ 68 system with a 4-axis electronic gearbox, together with NUM's new Flexium CAM suite of CNC software – including NUMgear – the machine is currently being used for research and development purposes, and has already highlighted the cost-saving and performance benefits of this latest generation CNC platform. It comprises a fully modular
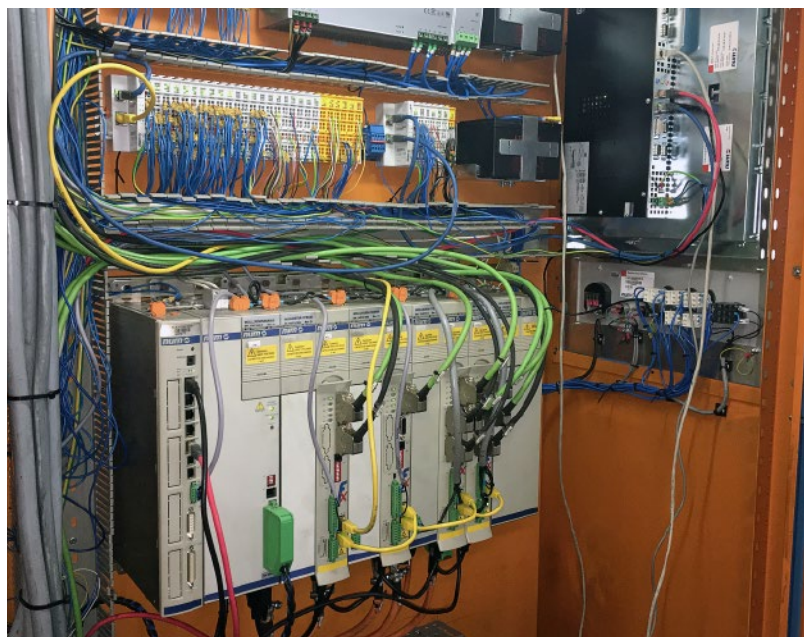
View inside the switching cabinet: a Flexium NCK (left), safe axis, multiple I/0 modules including Safe I/0 and the back side of the FS192i and MP05 (to the right).

Top right: a retrofitted Pfauter PE150 gear hobber.

Below left: FS192i with NUMgear HMI and MP05.

Below right: Test cutting a helical gear blank.

and scalable CNC solution for a wide variety of precision machine tool control applications, and includes a Safe PLC option and comprehensive safe motion control facilities.

The success of the Flexium⁺ based gear hobber rebuild has led Euro CNC to launch a development of an entirely new type of CNC gear shaper, that uses a highly advanced all-electronic control approach to facilitate the manufacture of helical gears. The company believes that the machine will set a new performance standard for automated production of complex gears when it is launched in the near future.

Retrofit

20-year partnership helps maintain tool grinding leadership

Star Cutter Company is a world leader in carbide and preform manufacturing, cutting tools and CNC machines for tool/cutter grinding and hob sharpening. Founded in Detroit back in 1927, the company nowadays operates six manufacturing facilities at strategic locations throughout Michigan. Since 1998, Star Cutter has partnered with NUM for cooperative development of application-specific CNC hardware and software. During the course of this nearly 20-year collaboration, the two companies have advanced cutting tool machine technology significantly – Star Cutter currently manufactures seven highly specialized lines of machine tools, six of which are based on NUM's CNC systems.

Star Cutter originally used Fanuc controllers for its machines. However, with a goal to bring it's customers even more capability and ease in realizing complex tool forms, to bring more flexibility and speed in integration of third-party motors and to simplify development of control software, the company sought to transition from a proprietary control scheme to a more open CNC platform.

According to Bradley Lawton, Chairman of Star Cutter Company, "NUM was an obvious choice. The company is renowned for the open architecture nature of its CNC solutions, and has

done much to remove the 'black box' mystique that is endemic to many of the competitive CNC products on the market. And the quality and reliability of NUM's products is excellent, which is extremely important to us – over 99% of the machines that we have produced in the past 20 years are still in everyday use. On top of that, NUM's customer support is superb and we enjoy very responsive and helpful technical help".

NUM and Star Cutter's partnership has undoubtedly created dividends for both companies, as well as for their customers and machine end-users. Starting

with its ETG and PTG series of tool and cutter grinders – which now have an installed base of more than 200 – Star Cutter has steadily migrated nearly all of its CNC machines across to NUM's control technology. About seven years ago, the company launched its highly successful ETG and NTG series of rotary tool grinders, including the advanced full linear NTG-6RL 5-axis grinder, which handles fluting, relief grinding and automated wheel change. All of these machines are based on NUM's CNC hardware and NUMROTO*plus* software.

Currently under development, Star Cutter's next generation machines are based entirely on NUM's powerful Flexium⁺ CNC platform. The NUMDrive X modules that form part of this highend CNC solution provide the drive flexibility that is needed to accommodate a variety of third-party linear and direct drive torque motors, as well as high frequency grinding spindle motors. As a consequence, the machines are capable of very high grinding and surface finish accuracies, combined with unprecedented grinding speeds, and promise to be the most productive that Star Cutter has ever produced.

Steven Schilling, General Manager of NUM Corporation in Naperville, Illinois, points out, "The higher bandwidth of the NUMDrive X servo drive and improved internal processing of NUM's Flexium⁺ CNC platform, which is now managed by double-precision IEEE 754 floating point, gives capability down to

Left: Engineered to manufacture complex cutting tools, the new Star NTG is a five axis grinder, powered by the Flexium⁺ CNC system.

Right: A traveling steady rest, fully integrated as the CNC's sixth axis, gives continuous tool support during grinding operations.

Middle: Star's PTG-1L Hob Grinder for manufacturing and re-sharpening of straight and spiral gash hobs.

Bottom: NUMROTOplus gives the operator complete flexibility in programming and simulation to grind the perfect tool.
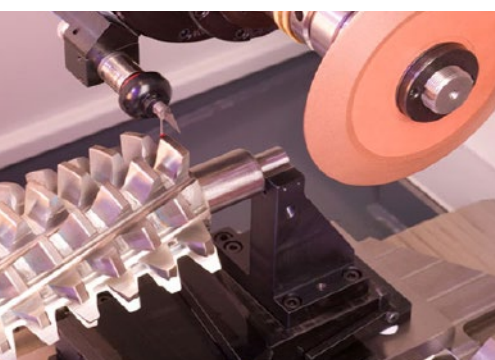
sub-nanometer accuracy. This provides manufacturers like Star Cutter with the opportunity to create machines that can grind even the smallest tools with superb accuracy."

Another key attribute of the Flexium⁺ platform is that it can run grinding programs as large as 40 MB directly from the NCK memory. And for very
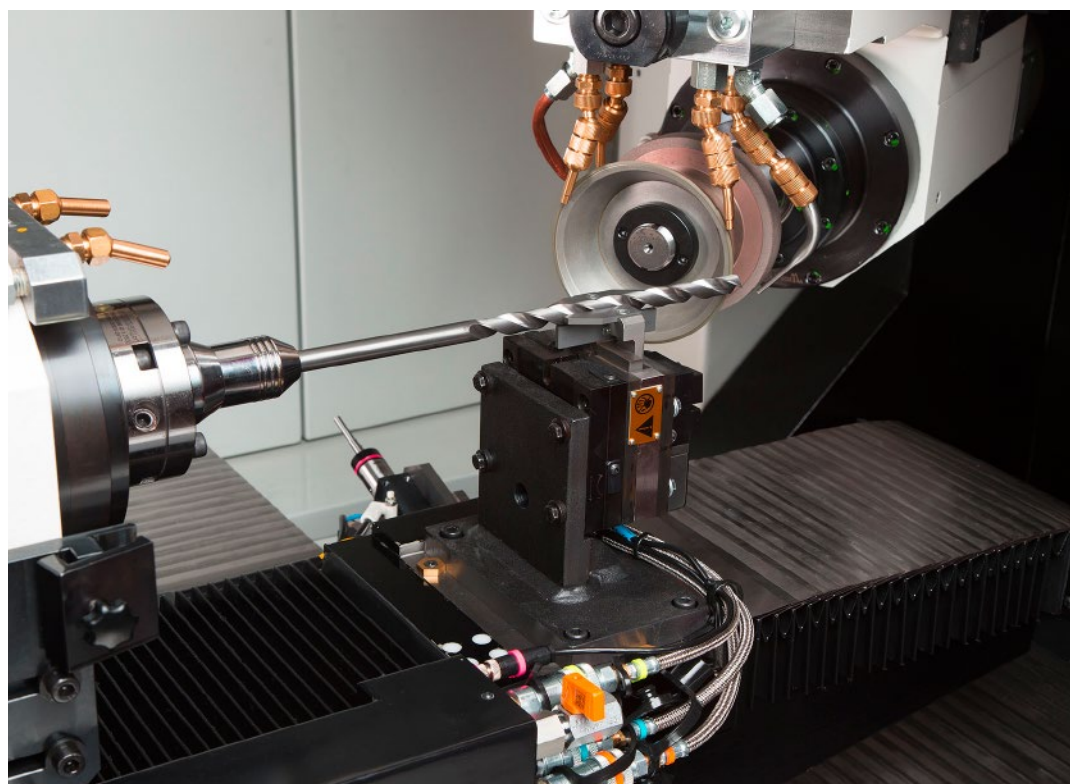
complex grinding cycles, the CNC system can execute cycles directly from the system's disk drive, via a high speed data transfer protocol. This increased capacity and speed helps Star Cutter's customers expand their CAD/CAM grinding operations. Whether it be the processing of advanced materials and aerospace components or medical devices and tools.

Star Cutter's new grinding machine also features a novel servo-assisted popup mechanical steady rest. This makes full use of the 'detachable axes' facility of Flexium⁺ systems equipped

with NUMDrive X modules. It enables end users to simply place the rest into the machine for the production of longer parts, and to quickly remove the full motor/mechanical assembly when it is not needed.

Focusing on an intuitive user experience, the operator station has been completely redesigned to reduce button pushing, and to simplify machine setups and daily operations. The optional 6 axis robotic part loader essentially programs itself from the NUMROTO tool files, requiring minimal user inputs. The robot can be set to alert shop personal of process completion or issues encountered during unattended production.

The new machine is also designed for ease of integration with other forms of industrial automation and handling robots. NUM's Flexium⁺ platform offers a wide variety of system communication busses, including EtherCAT, CAN and EtherNet. Measured process or post-process data can be fed back to the CNC system's NUMROTO software to provide on-the-fly corrections, facilitating adaptive real-time control of the entire grinding process. Shop floor data can even be shared easily with the rest of the plant and to the cloud with NUM's built-in MTConnect interface.

Thanks to Star Cutter and NUM, full lights-out tool and cutter grinding is now a practical possibility.

Partnership

Market leader in CNC dressing and profiling machines – A long-standing, successful, cooperative partnership with NUM

The focus of Rudolf Geiger Machinenbau GmbH lies on the development and design of CNC controlled dressing and profiling machines. For some time, Rudolf Geiger Machinenbau GmbH has been the market leader in the area of dressing and profiling of CBN and diamond wheels up to 800 mm. The consistent use of NUM CNC control systems on all machines delivered is an important part of our success. This long standing synergy between the two companies results in an even greater value to Geiger's customers.

Geiger has been using the NUM CNC control systems from the very start, which is about 20 years. "For our CNC machines, we want to use a control system that our clients in the tool grinding sector are already familiar with and use, which is why we chose to work with NUM," explains Georg Marvakis, CEO of Geiger. Clients know the easy operation, functionality and the quality of the NUM CNC control systems from the tool grinding sector because that is where NUM has been market leader with its NUMROTO for many years. This also means that there are no additional costs in terms of time or employee training for Geiger clients when it comes to working with Geiger dressing or profiling machines.

The Geiger dressing and profiling machines are used worldwide. Most of the machines are in Europe, USA, India and Asia. Because NUM maintains an international service network, the synergy can be used in the best way possible – ultimately to the advantage of clients thanks to quick problem solving at the end customer – by shorter downtimes and therefore limited loss of production. Apart from the development and design of standard and special machines, Geiger is a user as well and offers services like contract production, high-precision CNC milling, turning and grinding with up to 6 driven axles, laser structuring and labeling or production of precision parts for the medical sector.

True to the Geiger motto "Precision is our passion and constantly takes us further", the focus of Rudolf Geiger Maschinenebau GmbH lies on the development and design of high-precision CNC dressing and profiling machines with an accuracy range below 2 µm. By consistently upholding this precision, Geiger has managed to conquer the leading market position in this specific segment. For all new designs, Geiger systematically uses the NUM high-end product, the Flexium+ control system, putting Geiger at the top in automation technology as well. Allowing the end customer to use the entire spectrum of possibilities offered by the NUM Flexium+ CNC control system.

A precision grinding wheel is an important element for the tool grinder in tool production, because precise

From left to right: Mr. Georg Marvakis, CEO of Rudolf Geiger Maschinenbau GmbH, Mr. Johann Kutzberger, CNC/SPS Application Developer at Rudolf Geiger Maschinenbau GmbH and Bernhard Simon, Sales Engineer NUM Germany.

Right: View of the AP900 by Rudolf Geiger Maschinenbau GmbH with the NUM Fleixum+ CNC control system.

Middle: View of the AP900 – right, the large grinding wheel to be dressed – left, the silicon disk that precisely performs the dressing and profiling work on the grinding wheel. The profile that is being abraded by the silicon wheel can already be clearly recognized on the large grinding wheel.

Below: HMI of the software developed by Geiger for the AP900 dressing and profiling machine.
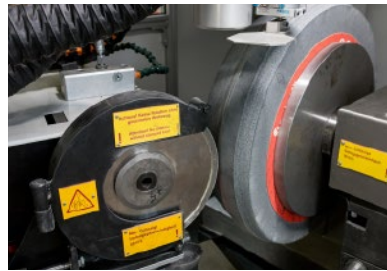
tools can only be produced over a longer period of time with a smartly dressed grinding wheel. Many tool grinders dress their grinding wheels inside the tool grinding machine. However, this results in downtime of the expensive tool grinder because while being dressed, no workpieces can be produced. By investing a dressing and profiling machine, the wheel dressing takes place parallel to tool production and the fully dressed grinding wheels can be inserted into the tool grinder as needed. The downtime for productive tool grinder is reduced to the minimum.

The AP900 CNC dressing and profiling machine, shown here, dresses grinding, with a wheel diameter of up to 800 mm and accurately work

with a maximum weight of up to 150 kg per wheel. The maximum width that can be dressed with this machine is 200 mm. The AP900 can also be loaded with a crane: A very important attribute since wheels can weigh up to 150 kg. Machine stability should also be emphasized since it ensures that the grinding wheels become perfectly round and have no nicks. This stability is achieved by the weight of the machine (almost 4 tons) and by constant improvements to the special design.

The software used on the AP900 was developed by Geiger in-house. It is menu driven and specifically adjusted to the eventual user of the dressing and profiling machine. "It is easy to use and self-explanatory. An operator can become proficient within 4-6 hours," Johann Kutzberger, the software developer, adds. By means of a simple 'teach-in' for the grinding wheel, anyone can independently perform dressing and profiling on the machine within a short period of time.

The data for dressing and profiling a grinding wheel can also be directly transferred from the tool manufacturer as a DXF file. The DXF file is then read into the dressing and profiling machine so that the grinding wheel can subsequently be dressed precisely. Using the reference values, the grinding wheel can
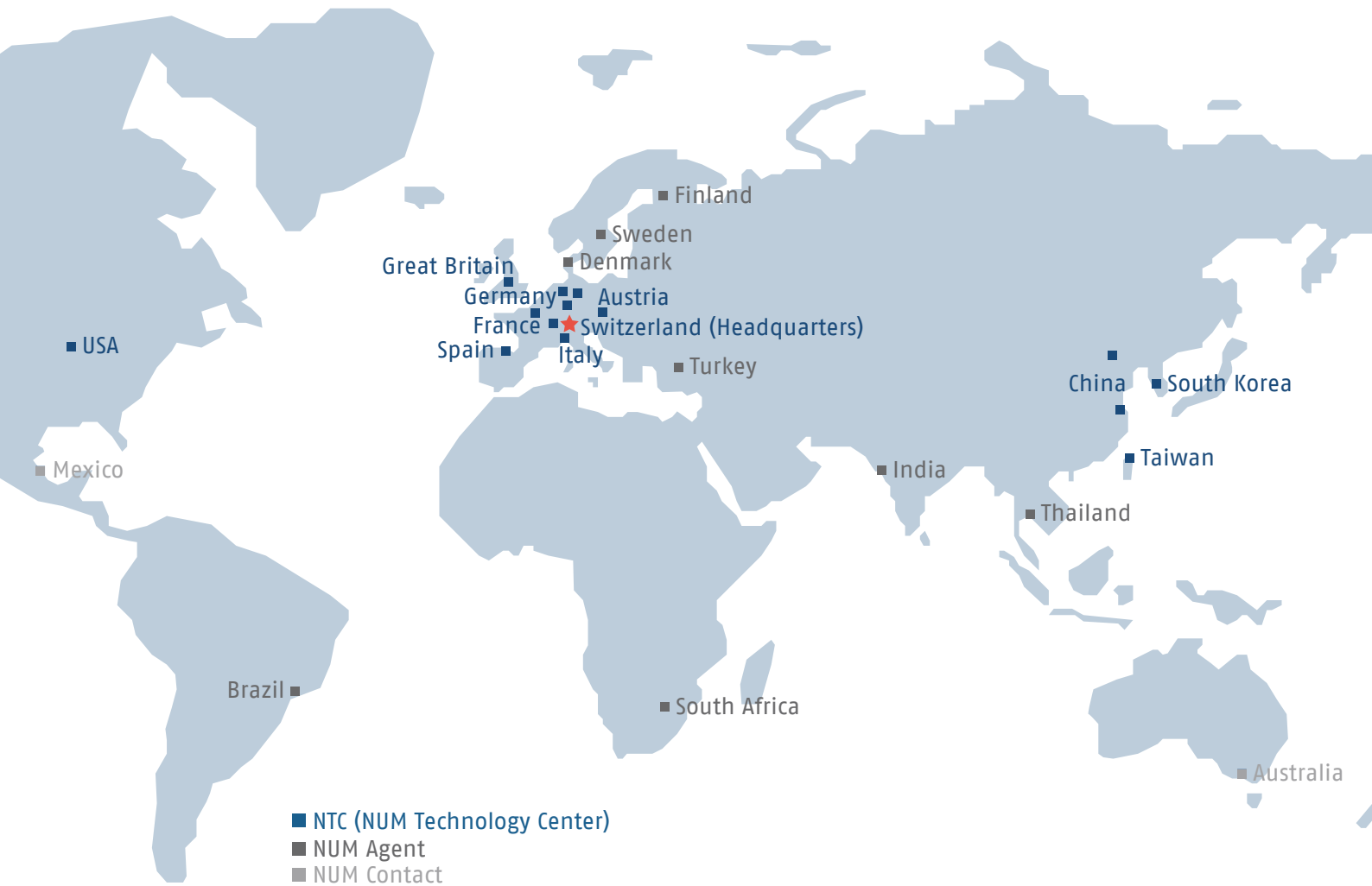
also be measured and reworked if necessary.

The AP900 also has an automatic dressing function, meaning that multiple identical grinding wheels can be dressed one after the other. All that needs to be done is to set up the data and then let the machine work through each grinding wheel on its own until the end of the process. The operator simply changes the wheel and returns the AP900 to zero, and starts the next cycle.

The AP900 uses silicon wheels to process CBN or diamond wheels. The silicon abrades the adhesive material in the grinding grains/diamond grains until, again, there are enough grinding grains/diamond grains in one line present on the grinding wheel. So the wheel is dressed again and sharp for use in the tool grinder.

Having software development in-house is another advantage of Geiger. It allows the company to meet specific demands of clients. Thanks to the long-standing, close partnership with NUM, even more complex special CNC machines can be customized, designed and built for clients. The AP900 proves once again that close collaboration between niche partners creates a competitive advantage in the market.

Synergies

Complete CNC Solutions Worldwide

num ®

CNC HighEnd Applications

Finland
Sweden
Great Britain
Denmark
Germany
Austria
France
Switzerland (Headquarters)
Spain
Italy
Turkey
USA
China
South Korea
Mexico
India
Taiwan
Thailand
Brazil
South Africa
Australia

- ■ NTC (NUM Technology Center)
- ■ NUM Agent
- ■ NUM Contact

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.

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