THE CNC AND SERVOMOTORS + DRIVES MAGAZINE

num information

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New PC panels

MACHINE-OUTIL 2004
Hall 5 - Stand B158

XYLEXPO
Hall 11 - Stand M16

PRODUITS
New for gear cutting

SOLUTION
Wooden mold machining

Num

Schneider Electric
Num : CNC Complete Solutions

"For 2004, *we have done everything to ensure success*"

Philippe Toinet, Sales and Marketing Manager, explains what Num did to prepare 2004.

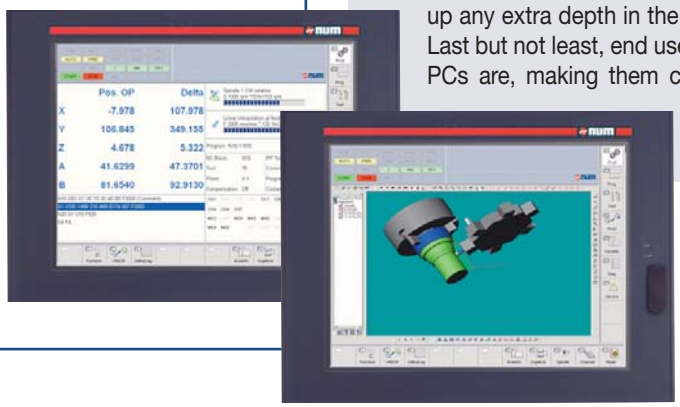
Philippe Toinet, Num Sales and Marketing Manager

Several changes were made to Num's organization in 2003. What is the situation today?
It is true that the repositioning of Num within Schneider Electric and more specifically within the Motion Control activity has given rise to several changes. The CNCs are now manufactured in the South of France in Carros, Schneider Electric's world production center for automatic control systems. In parallel, our plant in Argenteuil France was no longer suitable and was relocated to Colombes, another Paris suburb.
In Germany and the U.K., we also relocated to have premises better suited to our sales business, especially services. Last but not least, our subsidiaries now have new guidelines giving them more operational independence, which allows them to be more responsive and closer to their customers. That is quite a lot for one year. But as Claude Mandil, Executive Director of the International Energy Agency, said, to be efficient is to keep changing. I definitely believe that to improve, one mustn't be afraid of calling oneself into question.

How do you see 2004?
We have set up flexible dynamic structures with the aim of improving added value for our customers. For instance, we are organizing both our services and our product lines to have a global, relevant approach. We are also enriching and adapting our product line to be even better attuned to customer requirements. We have therefore done everything to ensure success. The main trade fairs such as Industrie 2004 (Machine-outil 2004) in France, Xylexpo in Italy, Grindtec in Germany, etc. that will be held during the first half of the year will be a good test to see whether our innovations are bearing fruit. As could be expected, we will be exposing our latest graphic functions (see box) that were already very popular at their preview at the Milan EMO and our new PC panels (see box). Finally, we will reassert our ambition to approach the market from a job-oriented angle, as is demonstrated by our gear cutting package (see opposite).

Num Provides Enhanced Graphic Functions

Previewed at the Milan EMO and Machine-outil 2004, Num's new graphic functions are the result of a partnership with DPTechnology aimed at integrating genuine milling and turning CAD/CAM capabilities in Axium Power CNC systems. Three levels of service will be available. The first, basic on PC panels, gives access to an especially user-friendly and tutorial 2D editor. The second provides 3D simulation of the machining program using the CNC's G functions. This level allows a genuine test to be made of the program, because the operator sees exactly how the machining operations will work, including special cycles. The third opens the CNC system to all the CAD functions of Esprit. This total integration of the CAD functions in the CNC gives it outstanding operational flexibility and takes into account all the engineering data.



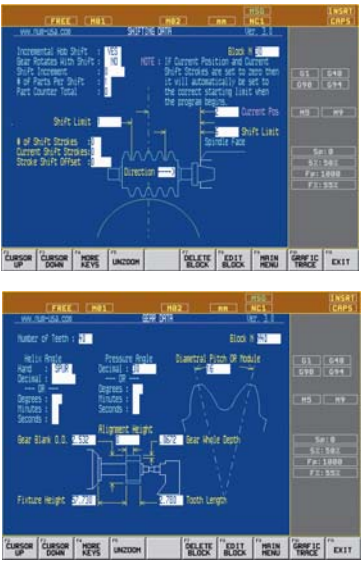
Num Expands Its Line of PC Panels

Shown for the first time at the Industrie 2004 trade fair in Paris, the latest Num PC panels boast an excellent price/performance/size tradeoff. Called iPCs Compact, they come with two different microprocessors: Pentium 4 1.7 GHz for SCADA type applications and Celeron 667 MHz for more conventional HMI applications. Their communication specifications - one Ethernet port, four RS 232 ports, two USB ports, two PCMCIA ports and one PCI port - allow them to adapt to almost any situation. The openness plus their computation power and their large memory will be particularly appreciated by OEMs looking for a panel to meet multiple needs, especially for job-oriented approaches.
Their 15" screen provides astonishingly good display quality under all environmental conditions. In addition, there are those who will appreciate the user-friendliness of a touch screen providing the function keys.
With their depth behind the front of 95 mm (the front itself has a depth of 5 mm), these new PC panels are very compact. In addition, all the ports are located underneath the case, facilitating their installation and not taking up any extra depth in the cabinet.
Last but not least, end users will certainly notice how rugged these new PCs are, making them capable of withstanding the bumps and jolts commonly encountered in industrial environments.

With their depth behind the front of 95 mm (front 5 mm), these new PC panels are very compact.

Gear Cutting

Cost-effective *solutions with* high performance!



To program the machine, the user is guided by a series of questions and answers plus graphic views.

It is easy to imagine the quality disruption caused by a manufacturing flaw in a gear. That is why gear cutting fully deserves special attention. Mindful of this, Num engineers have developed complete solutions to meet all basic needs.

The mechanical kinematics of a gear-cutting machine almost always has the same type of design (see Fig. 1). A spindle equipped within the tool head, along with a set of linear axes synchronized to the work piece, the machine has an exceptional ability to orchestrate tool head spindle and work piece axis movements with high precision. The number of synchronized axes differs according to the required degree of machining complexity.

Packages Engineered to Fit Your Process Requirement!

Supplementing it's milling functions, Num now offers two software packages dedicated to gear cutting, within the Num Power 1000 and Axium Power CNC families. Each package includes a complete set of G functions for gear generation by grinding wheel or hob cutters, as well as tool change and retraction macros.

With the basic package, the CNC synchronizes cutter rotation and axial tool motion (Z axis) with the rotation of the work piece (C axis). This configuration is therefore principally designed for the simplest machines with three axes (X, Z and C) plus a spindle.

With the second package, the CNC adds tangential tool movement (Y axis) to the synchronization of the Z and C axes. In addition to covering applications with up to 6 axes (X, Y, Z, A, C, and W) plus a spindle, this solution also extends the range of manufacturing of bevel gears and helical gears with straight or conical cutting tools.

To these two new packages is added the gear alignment functionality, giving the following capabilities:

- Re-cut a previously machined gear.
- Setting the angular alignment of corresponding teeth, when multiple gears are generated on the same shaft. (see photo).
- Automatic gear alignment: Built-in cutting tool and gear re-synchronization, via a non-contact sensor, allowing for automatic "tool-work piece" timing pickup, when reintroducing a precut or hardened gear into the machine.

Job-Oriented Graphics Empower the User!

Faithful to its job-oriented approach, Num has also developed an interactive graphic user interface (HMI).

(end page 4)

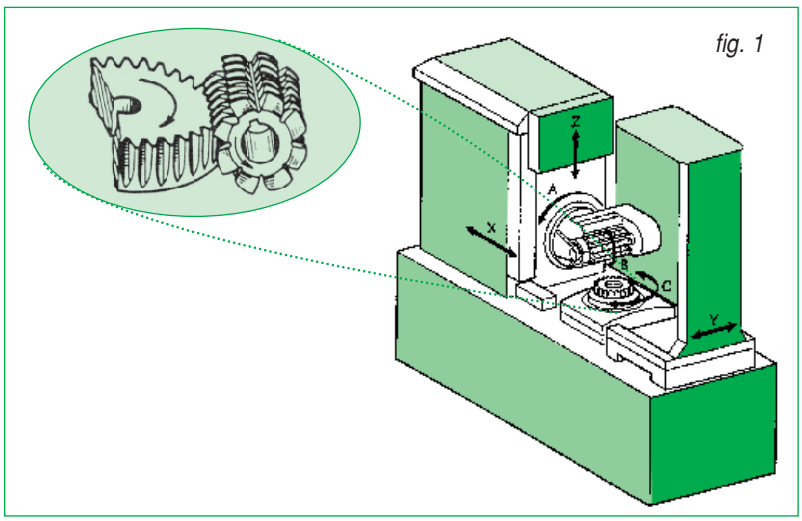


fig. 1

X axis – radial feed of the hob with respect to the gear; Y axis – tangential movement of the hob to cater for tool wear or generation of gears with tapered teeth; Z axis – axial movement of the hob thru the gear during machining; A axis – tool head swivel to mate the hob angle to the gear tooth angle; C axis – work piece rotation; S – tool head spindle rotation.

Building **Europe** *around* **machine tools**

Swift had a strong need for flexibility because of the large number of variants in its production.

Since 1960, Cosmec has been making special wood- and plastic-working machines. This Italian manufacturer has a catalog of several basic machines that can be customized and tailored to meet the needs of each customer. Cosmec works in a great variety of fields, but they all share one common requirement: flexibility.

An Italian OEM, A British User and a French Manufacturer

Swift is a leading British manufacturer of trailers and recreational vehicles known in particular for the quality and elegance of its interior wood furnishings. Swift recently decided to restructure its furniture production. It finally chose an Italian Cosmec machine because of its speed and accuracy, and the support of their import agent, VWM woodworking, who are one of the UK's leading suppliers of new and used CNC machining centers.

The system chosen was a NR machining center with fixed gantry and moving beds. Two 3-axis toolheads with a power rating of 10 kW each, include a 12-position tool changer. Two separate worktables allow loading and unloading to be carried out in masked time while machining continues on the other table.

The machining center is controlled by a Num Power 1050 CNC system. "We needed accuracy and computational power to control the entire mechanical system of the machine simultaneously to guarantee maximum time optimization," explained Dott Dimitri Tansini, owner of Cosmec. "And Swift wanted a machine that was compatible with its existing machines." This pan-European operation will continue, since Swift has ordered other machines!

Gear Cutting (end)

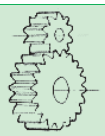
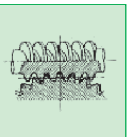
This HMI allows the user to create complex gear machining programs simply by answering a number of questions concerning the cutting tool and the gear to be generated (see photos). There is no need to know the ISO language! This operation is simplified even more by the graphic view of the different elements (work pieces and tools).

The user interface also provides tool wear management, which contributes to optimizing the life of an often costly, cutting tool, by automatic shifting over the tool's working length. This tool management approach is especially advantageous in helping to avoid process size variations and thereby allows high part quality to be preserved over time.

The aim of these new functionalities is to provide a cost-effective solution for the most common applications for new or reengineered machines. For more special needs, Num does not hesitate to put its experience to use to find a suitable solution (see article, page 11).

Examples of several gears on the same shaft.

Summary of the capabilities offered by the new gear cutting packages (available/unavailable)

CNC System	Number of axes Min/Max	Basic package	Advanced package				
Num Power 1020	3/4	●	○	●	○	○	○
Num Power 1040	3/5	●	●	●	●	●	●
Num Power 1060	3/8	●	●	●	●	●	●
Num Power 1080	3/32	●	●	●	●	●	●
Axium Power	4/32	●	●	●	●	●	●

How to cut through **160 mm** *of titanium* **with water ?**

The advantages of a pressurized waterjet for cutting cotton, food and certain metals are well known but until now, these techniques have been used only for materials of reasonable hardness and thickness. At Snecma Moteurs, Aquarese have designed a machine to cut through titanium parts more than 100 mm thick.

The French company Aquarese specializes in the integration of ultrahigh pressure (2000 to 4000 bar) applications of this technology for a wide variety of uses such as cutting, pickling, deburring, etc. "Our services range from feasibility studies to equipment supply," explains Bruno Galiot, head of the Automatic Controls R&D Department at Aquarese. "We tailor our services exactly to the customer's needs so as to develop a long-term partnership which allows us to build on joint know-how." In this context, Aquarese had to meet a real challenge from Snecma Moteurs to demonstrate the economic advantages of 5-axis waterjet cutting over rough milling of titanium aviation parts more than 100 mm thick.

Line of turbojets produced by Snecma Moteurs (Snecma Photo)

Challenge met...

… even if some problems remain to be solved to make the process fully reliable, several difficulties have already been overcome. First, the thickness and nature of the material. Water-jet cutting can be pictured as wire cutting, with one end of the wire left free. It is then easy to understand that the longer the jet, which is the case for thicker parts, the harder it is to control the jet's reactions as it moves across the part. Moreover, this is the first time this technique has been used in the aviation industry for such thicknesses, and the results are quite satisfactory for thicknesses up to 160 mm! At the same time, titanium is the metal with the highest strength-to-weight ratio of all the known structural metals. That is why it is so hard to machine, especially in this case, which involves more than ordinary cutting and is much more like machining."

The machine includes a 5-axis gantry and a rotary table. The axis system is controlled by an Axium Power CNC. The use of the RTCP (Rotation around Tool Center Point) function improves control of the water-jet's trailing angle, dependant on the direction of movement. Because the Axium Power system is so open, it was easy to integrate pages dedicated to this application in the system HMI.

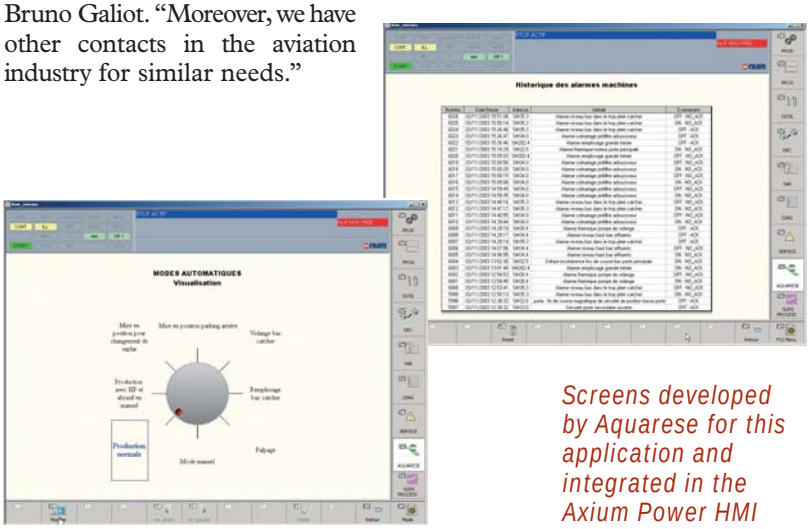
Process Monitoring Integrated in the HMI

For reasons of safety, reliability and traceability, it is mandatory to continuously record the water-jet flow rate, abrasive flow rate, etc. during machining. Any undue drift in these parameters can be precursors of manufacturing defects. It is therefore essential for this data to be continuously accessible.

"We developed two new contexts that we added to the existing ones of the CNC," says Bruno Galiot. "The first context is a 'process monitor' which shows a graphic view of the parameters being monitored by the PLC. This view allows true quality monitoring since all the events that occurred during production can be related to a specific part serial number. A second context key, labeled 'Aquarese', gives access to maintenance functions." The data is saved on the hard drive of the PC panel and is accessible via the data network. Similarly, part programs can be transferred directly from CAD/CAM.

"This machine has undeniable economic and technical advantages," concludes Bruno Galiot. "Moreover, we have other contacts in the aviation industry for similar needs."

Machine control panel



Screens developed by Aquarese for this application and integrated in the Axium Power HMI

Retrofitted with an Axium Power, this induction quenching machine is used for processing steering rack shafts.

Automotive Subcontracting

An induction quenching machine, a huron machining center … KSDSE is renovating its equipment

Inductor movement relative to the part must be flawlessly controlled.

KSDSE is a specialist in the production of steering systems for automobiles who have chosen Axium Power to retrofit several of its machines.

With the appearance and rapid growth of power steering systems, the role played by such systems in the success of a model has greatly increased. The gains in reliability, size, cost, etc. are assets which benefit the automotive manufacturer as well.

When it purchased PSA Peugeot Citroën's Dijon plant in 2000, the Japanese Koyo group, second manufacturer in the world for steering systems, was well aware of the advantages of acquiring a production unit that had already been a leader in this area for several years. For KSDSE (Koyo Steering Dijon Saint-Etienne), the induction quenching know-how has given rise to special developments for producing the inductor now sold by the company to other plants within the group. It was therefore understandable for KSDSE to pay particular attention to the maintenance of its production tool by retrofitting a three-axis induction quenching machine.

Induction Quenching, A Specialist's Job

This process, used especially with steels, consists of almost instantaneously heating the surface of a part to around 900°C, then cooling it very rapidly. The part is heated by induction or eddy currents currents. The quality of the results depends on two factors, the frequency and the shape of the inductor. The first process gives the steering rack excellent hardness properties. But if it were left as is, it would be like glass: both hard and brittle. In 2003, as it was starting on new productions, KSDSE decided to re-engineer a steering shaft induction quenching machine. "Induction quenching is not a fast process." explains Jean-Pierre Rzeczynski of the induction quenching shop. "Our output is around one part per minute. However, it is essential to control the space between the inductor and the part very accurately, because the quality of the result depends on this. These measurements will allow the inductor to be positioned flawlessly with respect to the part." It is the CNC that makes the measurements and moves the inductor along the part.

In addition to the usual advantages of retrofitting, such as extending the life of a machine and/or obtaining a more user-friendly and powerful HMI, the replacement of the old system with an Axium Power makes settings more flexible, especially for measurements. "We no longer have to measure positions at a specific number of fixed points," continues Jean-Pierre Rzeczynski, "which allows us to consider using this machine for smaller production runs."

This retrofit was especially beneficial by making the tool changer control more reliable and optimizing it.

When Reliability and Optimization Are Combined!

"First we want to ensure the operational reliability of our tool changer, which supports 56 tools." says Michel Lambert, of the Maintenance Department, "This 6-axis machining center allows three steering boxes to be assembled simultaneously. To machine them, we make approximately 12 tool changes per cycle. Before the retrofit a relatively complex sequenced control regularly led to errors in tool changes and thus to machine stoppages. Now, by controlling this function as an axis, the position of the tool changer is much more accurate and the arm that comes to get the tool is correctly positioned in front of the next tool."

This operation required re-writing the PLC program, which is now in Ladder, making it much easier to understand and maintain. However, only a few minor adaptations were required to the part programs, necessary to benefit from newly available functions, such as rigid tapping.

Woodworking

Entrance doors made **to order on the production line**

With its new MKM machining center controlled by a Num CNC, Kegro is fully equipped to produce one off doors of various shapes.

Five Num 1080 CNCs control the system machining stations. They are integrated in a TCP/IP network and communicate with a special server program.

The Dutch manufacturer Kegro Deuren is capable of making any and all external doors simply by measuring the opening. External doors are much more varied and complicated to manufacture than internal doors. However, Jan Hermanussen, Production Manager at Kegro, is not complaining about this diversity. "For many years, we have been making made-to-order external doors, but we needed to automate production to become cost-effective." The German company MKM won the contract. For major projects like this, Klaus Baumann, MKM manager, called on longstanding partners such as Num. "We used five Num Power 1080 CNCs allowing us to control up to 32 axes divided into a maximum of 8 groups."

Three Major Assets: Flexibility, Quality and Speed

The system includes five machining stations, a feed robot at the head of the line, the stacking system at the end and a roller conveyor to transport the doors. The head of the line consists of a gantry milling machine for profiling the doors. All the data relative to the door profile is communicated to the milling machine by a bar code.

When both straight and curved doors have been profiled, a transfer conveyor loads it onto a roller conveyor which brings it to the next station, and so forth. " The main challenge was to accurately position doors of different shapes," continues Klaus Baumann. "To do this, we installed totally flexible stops at each station. The door dimensions and possible radius of curvature are known, so that Y axis stops can be adjusted accordingly. We can thus position, clamp and machine the profiled doors accurately at each station."

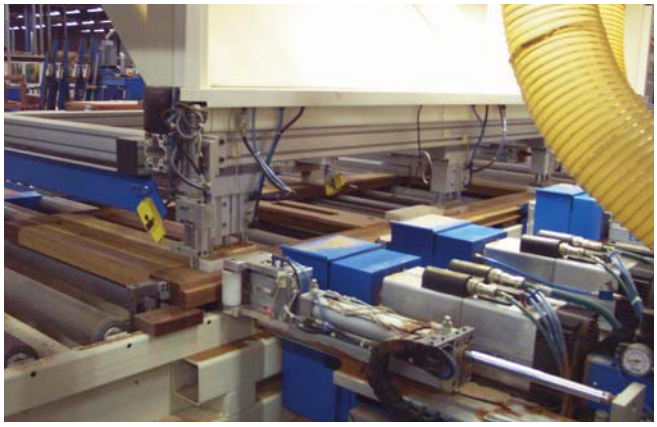
Deadlines were of course an additional challenge. "We are renowned for three major reasons: flexibility, quality and speed," explains Jan Hermanussen, "and this system contributes a lot to that success." This is obviously due to the mechanical systems but also to a large extent to the electronics and the software written by the German company Techni-Soft. Each of the five machines equipped with CNCs, the feed robot, the roller conveyor and the stacking unit are independent units. This allows the components on the machining stations to be controlled separately. A PC communicating with the CNC is connected to each station.

A client program specific to each station collects data such as "door on conveyor", "failure", etc. It transmits this data to a specially developed server program via a TCP/IP network. The server program analyzes the data received from the clients and sends back instructions. These are instructions like "finish machining" or "prepare machining", etc.

The system is very flexible because the CNC programs for the different machines are not generated until the bar code has been read. Changes remain possible up to that point. In addition, the CNCs have 3D macros allowing them to produce curved parts. The only programming required is interactive data entry into template masks for variants of flat parts. Similarly, polynomial interpolation optimizes path following, allowing flawless smoothing.

This networking concept has the enormous advantage of simplifying the wiring. And it was possible to do away with quite a few hardware components. For instance, the exact thickness of the door is measured on the first machine and communicated to the server program. As soon as the door reaches one of the other machines, the measured thickness is communicated to its client program which then sets it in a PLC parameter. The parameter is then used by that CNC's program.

The main challenge was to accurately position doors of different shapes.



The Hawemat 2001CNC grinding machine is the most sophisticated of the Hawema 5-axis grinding machines equipped with a CNC.

Tool Grinding

Facilitate tool **sharpening**

Tool grinding encompasses the production of new tools and tool re-sharpening. The second activity is much more prevalent and the work is often more difficult. The association of new HAWEMAT grinders equipped with Num CNCs and NUMROTOplus, software, the world leader in this specialty, provides a complete and effective solution.

Many standard and special tools are in daily use for machining metals. When they become blunt, these valuable items are not scrapped straight away, because they can be re-sharpened several times. However, this can become a difficult job with complex tool geometries.
Hubert Haller, Manager of Hawema Werkzeugschleifmaschinen GmbH located in Trossingen, is a tool grinding expert. Hawema, the company he created in 1993, works mainly on developing and manufacturing grinding machines equipped with numerical controls, and it has been very successful. The 5-axis Hawemat 2000CNC grinding machine introduced in 1997 has won several awards for its innovative design. This machine was used as the basis for the Hawemat 3000 and 2001 grinding machines. The Hawemat 2001 specializes in tool sharpening and the production of small tools. The Hawemat 3000 grinding machine is specially designed for manufacturing new and special purpose tools.

Only Num!

In parallel with the development of the Hawemat 2001CNC grinding machine, Hubert Haller took a new step in innovation: a strong partnership with Num as the single source for all the electrotechnical parts and software. "We already had Num CNCs and the NUMROTOplus, software alongside other makes. A year ago, we decided to work with Num alone. In effect, Num proposes software that is an international benchmark for tool grinding, combined with the new Axium Power Level 1 CNC and MBLE axis drives, a drive system that is just right for our machines. For our production we thus have all the electronic circuitry and software grouped in a single package." Another advantage is that Num provides service all over the world. Some of Hawema's licensees are located in America and Asia where they produce for their local markets. They also use complete Num packages.

NUMROTO*plus*® – Some of its advantages

- A wide range of tools from simple drill bits to special complex cutters
- Tool manufacture and sharpening
- 2D and 3D simulation
- Interfaces with the measuring system and CAD/CAM
- Networking
- Software, CNC and drive included in a single unit
- Individual training for beginners and experienced users

The Rolls Royce of Grinding Programs

Metzmeier Werkzeugservice GmbH located in Villingen-Schwenningen is one of Hawema's loyal customers. This specialist tool grinding service company invested at the end of last year in a Hawemat 2001, as explains their manager, Klaus Metzmeier. "We are increasingly receiving requests for special tools and we have to be able to satisfy them. But that is only possible with a machine equipped with software that is easy to use and capable of producing complete tools. In our opinion, NUMROTOplus, is the Rolls Royce of grinding software, and that is exactly what we want for our customers."
In addition to the reliability of the machine, the CNC and the software, Klaus Metzmeier appreciates the system's great flexibility. The programs can be assembled like the tiles in a mosaic, then simulated for appraisal. Klaus Metzmeier adds, "What I like most is the possibility of calculating the entire grinding operation. Approximations are replaced by exact calculations supplied by the system in record time, which allows me to give my customers realistic information."
Among its customers, Hawema counts Gühring, DaimlerChrysler, HAM, Aesculap and many other renowned companies specialized in grinding. Currently, more than 250 Hawemat grinding machines are in use around the world.

Because of the requirement to determining their contour, sharpening tools accurately is a very complex job which can be even more difficult than the production of new tools.

Hubert Haller, manager of Hawema: "With its world benchmark tool grinding software, its new Axium Power CNC and its MBLE axis drives, Num is the ideal partner for me."

Good workmanship *patterns*

An new Italian company has selected Num's numerical control technology for machining its thermoforming patterns.

The qualities of the Num Drive CNC and feedback systems proved to be essential for making certain patterns, as the complexity of the profiles and machining difficulties were reduced by this HMI adapted to our job.

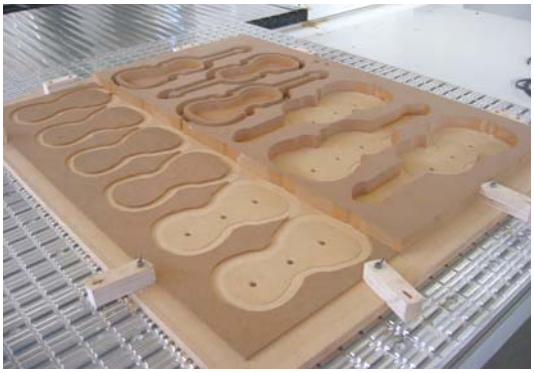
Modeltek s.r.l. is a dynamic Italian company specializing in woodworking and light alloy metalworking for molds.
The company was created in 2002 and rapidly gained a reputation among mold manufacturers and thermoformers through its know-how and its capability to satisfy special requirements, particularly in the area of tyres for large machinery (earthworking machinery and agricultural implements). Among its customers it counts renowned Italian manufacturers.

From Design to Machining

"Because of our experience in this field," begins Massimiliano Salvarani, Technical Manager, "Modeltek is capable of handling a complete project. Sometimes without even knowing exactly how the final part will look. We make a sketch of the pattern and after a 3D analysis of the machining process simulated by CAD, we produce a preproduction run with the different phases of adjustment, assembly and testing of molds and masks, supplemented by cutting programs for finished plastics."
The patterns can have geometries with simple or complex contours, up to maximum dimensions of 4000 x 1360 x 1300 mm.
The design and manufacture of the part surface require many hours of study, programming and cutting, since a certain degree of smoothness and precision are required for the pressure thermoforming process. The plastic film is heated and adheres to the mold by a combination of compressed air pressure and vacuum, allowing deep recesses and cavities to be made.
A latest generation Routech-CTC machining center is used to make the patterns as it can handle different types of materials, such as wood and aluminum. An impressive productivity is obtained on this machining center, with high installed power and a strong mechanical structure combined with precise movement on five interpolated axes with a high dynamic range.
"Because of its simplified programming using machining cycles, the Num Power 1050 contributes to optimizing the work of the people responsible for designing and making the patterns," continues Massimiliano Salvarani. "The digital technology of the CNC-feedback system also allows us to achieve relatively high machining precision."

Maximum Collaboration

"The qualities of the Num Drive CNC and feedback systems," explains Massimiliano Salvarani, "proved to be essential for making certain patterns, as the complexity of the profiles and machining difficulties were reduced by this HMI adapted to our job.
Because of its architecture and the high performance of the drives (axes and spindles), the Num Power 1050 system is a very flexible sophisticated instrument for us mold makers, as we machine all sorts of patterns, using both by external CAD and onboard programming.
"Integration of the PC panel in the CNC increased the system's potential by providing an HMI configurable for any application, the possibility of communicating with the most widely used graphic programs, compatibility with the most common operating systems and connection to the most widespread networks.
"So you see," concludes Massimiliano Salvarani, "these strong points of Num give us all the guarantees we need to meet the expectations of our customers and prevail over increasingly fierce competition."



The five-axis head of the Routech-CTC machining center contributes to the machine's productivity.

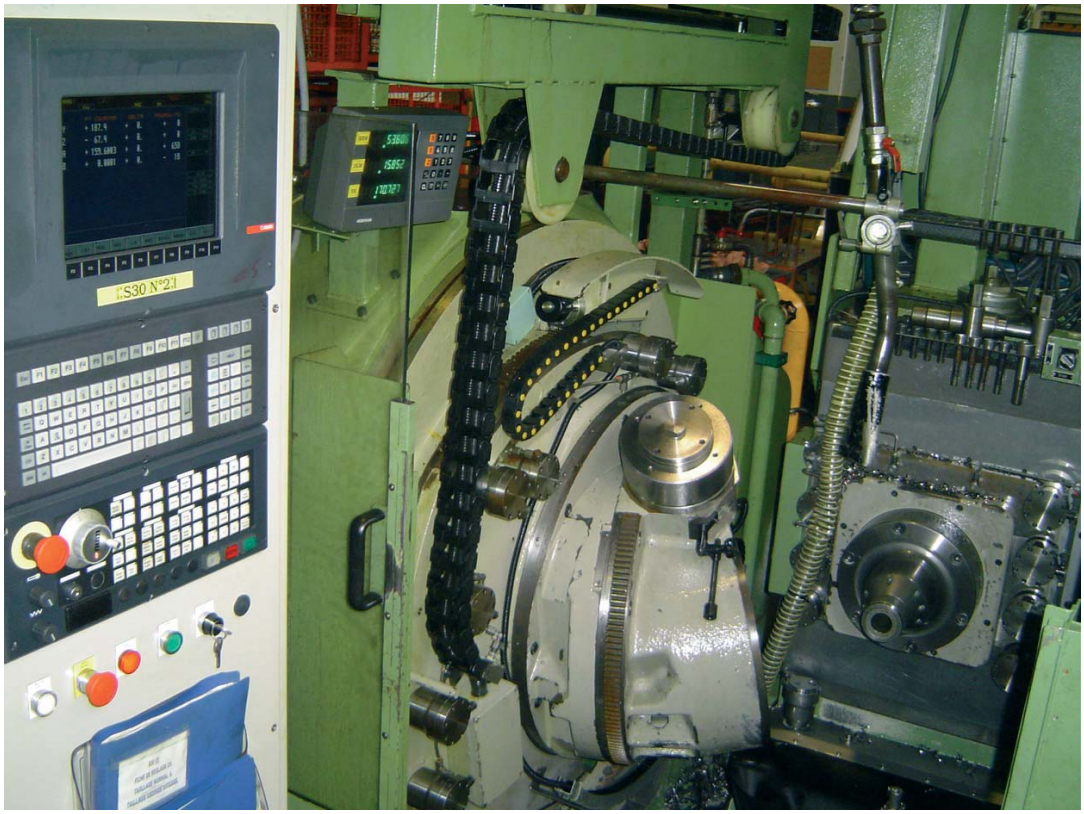
Examples of products

Spiral Bevel Gears

A job-oriented approach **makes all the difference !**

Experience reduces risk. This was especially true when it involved putting a finger in a pie and that pie was a spiral bevel gear! That is what Num and Arielec did when re-engineering gear cutting machines at RVI.

When you start looking into gears, you cannot fail to be impressed by their diversity and complexity. First you need to choose the geometry according to the required transmission characteristics, then to use mathematical formulas to calculate the mechanical specifications of the parts, based on the feed rate, torque, material, etc. For instance, a helical gear train with parallel axes provides a gradual meshing with a large number of teeth in contact, giving a continuous drive with a smooth, quiet transmission. If, in addition to having helical teeth, the gear and pinion are tapered instead of cylindrical, then you have a spiral bevel gear (see photo) or even hypoid gear if the axes of the gear and pinion are not in line.
So, if designing a gear is job for specialists, what about manufacturing them?



Oerlikon S30 machine

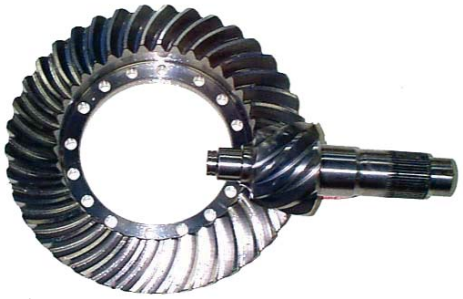
A Special Trade!

Gear cutting machines are so special that when Renault Véhicules Industriels planned to re-engineer two Oerlikon S30 gear shapers (4 digital axes and 6 measured axes for positioning the cutter and workpiece spindles), replacement of the CNC was a real problem. How could they retain functions specially developed for machining hypoid gears and essential for guaranteeing the same level of service as before, while at the same time increasing cutting speeds?
These machines used dedicated gear cutting CNCs designed exclusively by their OEMs, but these manufactures had ceased trading years ago. There was practically no documentation on the machines; in other words, what they did was well known but how they did it was a mystery.
Replacement of this "black box" and the axis drives on these machines was a real challenge. That is why Renault VI decided to rely on the know-how of Arielec and Num, and to contract the entire re-engineering to them.
"The first step in the process was to make an analysis of the old drive chain in order to modify certain mechanical ratios and yet stay compatible with the original design concept." explained Denis Castang from Num, with the help of Jean Merlin and Philippe Ollier from Renault VI and Marcel Bastide from Arielec.
On this level, Num's experience with gear cutting proved very useful, because from an existing base, it allowed Num to tailor the CNC exactly to the needs of Renault VI with Num digital reference feedback systems whose torque capabilities are especially well suited to ensuring the mechanical stability needed to guarantee the quality of machining.
Four functions were specially developed for this manufacturer. They were designed using dynamic operators in C. The first function can automatically calculate the synchronization coefficients between the workpiece spindle, the cutter spindle and the Y axis, which greatly simplifies the operator's job.

The second function consists of programming the cutting pass with different start and end feed rates. By moving an axis this way, chip removal is improved and machining generally proceeds under better conditions.
The third function, switching the cutter spindle to become an axis or a spindle (change to C axis) allows accurate reworking and several passes on a given tooth.
Finally, the fourth function developed is an important enhancement over what existed before: emergency retraction of the tool in synchronization with the workpiece, even in the case of a power failure. This is achieved by intelligently managing the available dying resources between the axes so as to allow hob retraction without breakage. Hobs are very expensive tools and any safety system that preserves them is a major asset.
One more advantage: the openness of the Axium Power system made it possible to give the HMI the same look and feel as the original one. Here again, this is advantageous for the user, who can resume production as though nothing had changed… well, almost, except for the huge gains in productivity!

Speed Doubled!!

The new CNC associated with Num HP Drives and Num Drive motors really boosted the performance of these two machines. The spindle speed is now nearly 250 rpm, up from around 130 rpm, which has real advantages for productivity; in addition, it was possible to preserve the many gear cutting tools designed over the years to meet special needs!
In conclusion, it is often possible to re-engineer a machine, even a very complex one that is old and relatively undocumented, subject to choosing an open, high performance system and a CNC manufacturer with the expertise necessary to understand the application, plus the special know-how of the customer and the OEM.

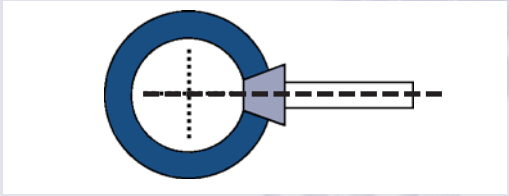


Spiral bevel gear

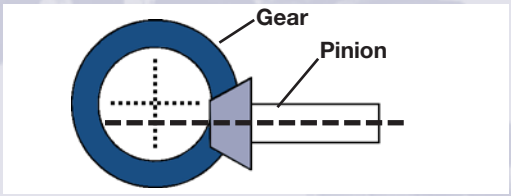
Hypoid gears

What is a bevel gear pair?

There are two types:



Spiral bevel gear



Hypoid gear

In the case of a spiral bevel gear, the gear axis is aligned with the pinion axis and the pinion and gear have the same helix angle. In hypoid gears, the pinion axis is offset from the gear axis. The pinion and gear have different helix angles and the pinion angle increases with the offset.
All the gear pairs made by RVI are hypoid because the offset increases the load capacity and this design allows a larger pinion diameter for a minimum gear diameter. That is one of the reasons RVI gear pairs are smaller than those of the competitors.

The teeth can have two types of profile:

As a general rule, the gear pairs manufactured by RVI have ungenerated teeth. The gear tooth profile is straight (formate) and the pinion tooth profile is curved. (the gear cutting time is shorter when the teeth are ungenerated).

UNGENERATED TEETH
(FORMATE GEAR)

GENERATED TEETH

Gear cutting is carried out in two modes:

- Continuous division (Oerlikon)
All the teeth are machined simultaneously, the tooth edge is epicycloidal and cannot be reground.
- Intermittent division (Gleason)
The teeth are cut in succession, the tooth edge is an arc that can be reground.
RVI gears are cut by continuous division as this technique is more capable of withstanding bending stresses because of the tooth shape, allowing a more stable bearing surface under load.

P. Ollier of RVI

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