Heller

INTRODUCES GEAR MANUFACTURING ON FIVE-AXIS MILLING MACHINES

Heller has developed a process that enhances the productivity of milling operations on a 5-axis machining center.

Manufacturers of gear components and bevel gears have been looking for alternatives to traditional manufacturing processes for larger gears. In addition, improving machine tool flexibility has become more important because many gear-makers can no longer afford to depend on dedicated gear machine tools. They want the capability and flexibility typical of a machining center.

In co-operation with Voith, a major transmission manufacturer in Germany, Heller has developed a process that significantly enhances the productivity of pre-milling and gear milling operations performed on a single 5-axis machining center. Both companies have applied for a patent on the jointly developed process.

The process is aimed at manufacturers of vehicles, machines or machine components that can use the machining center for lower-volume production of larger gears as well as other machining tasks.

Gear milling has recently been an interest of some machine tool builders as it is more efficient to use the existing capability of a five-axis machining center for new applications beyond those typical for machining centers. According to Heller, gear milling provides an ideal opportunity to use the full potential of its 5-axis machining centers from its new F series machines to its heavy-duty MCH-C series.

Heller pointed out that traditional gear-making machine manufacturers continue to concentrate on special-purpose machines and tools dedicated to gear machining, but that manufacturers of machining centers can provide complete machining for a wide range of applications as well as solutions for gear modeling using special software. The software permits the user to generate an ideal gear geometry from which the gear-making process can be developed.

Gear Data Drives the Program

Technical literature on gear technology says there is no comprehensive mathematical model for bevel gear tooth systems. Therefore, every CAD model used for the CAD/CAM process is an approximated model. Traditional gear cutting machines are based on a specific machine structure with corresponding kinematics. The machine generates the appropriate tooth shape based on the setting parameters entered into the machine.

The approach taken by Heller is a totally different one, although it resembles the process used with most dedicated gear machines: i.e., the gear parameters specified on the drawing are directly input into the machine control. The control then uses the data to generate the 5-axis paths for roughing and finishing in real time. As a result, no mathematically accurate 3-D geometry model is required. Instead, the pre-defined gear data from the drawing are used.

The measuring machine reports compensation data that can be directly entered in the machine control for pro-

cessing. Another major benefit of this approach is that current tool data, such as tool wear, can be incorporated into the ongoing process in real time. As a result, precision is enhanced. Also, the process provides users with flexibility and productivity without creating a new dependency on special software.

Besides tooth space machining, Heller also provides a process solution for pre-milling/turning of blanks. Complete pre-machining of external and internal contours is possible in the first setup, while tooth milling takes place in the second. Specially adapted NC cycles have been developed to facilitate process control. As a result, the complete workpiece can be machined on a single machine.

New Type of Cutter Raises Productivity by 300 Percent

There are other 5-axis machining centers claiming to be equally versatile and suited for gear milling when programmed accordingly. The use of an end milling cutter, for instance, provides high flexibility.

But according to Dr. Hannes Zipse, business development manager at Heller, the method is not particularly efficient or productive. "We operate in fields with high chip removal rates and aim to achieve the same in gear milling. We cooperated with Sandvik Coromant to develop a customized crown-milling cutter with indexable inserts, resulting in a type of hob. This had a major role in increasing productivity by the factor of three compared to conventional methods. The wider the tooth space, the more productive we will be."

The level of productivity essentially depends on the static and dynamic stability of the machine. For Reinhold Siegler, head of technology development at Heller, this is the most important point of all. "Very compact clamping is essential. That means that the position of the pallet chuck in the Heller solution is very close to the upper pallet edge to enable deep clamping of the gear or bevel gear.

"Additionally, our extremely robust spindles and highly rigid machine elements plus the use of short tools designed for roughing are key benefits. For this reason, we achieve higher productivity in the roughing

operation than can a vertical machining process," he said.

Versatility

The new process is for workpieces of different sizes starting from gear module 4: the smaller Heller 5-axis machining center model FP 2000 for diameters of up to 720 mm, the larger model FP 4000 for diameters of up to 900 mm, the model MCH-C with HSK100-spindle taper for diameters of up to 1,800 mm and an upcoming new machine range for diameters of up to 3,000 mm.

Despite the time-consuming changeover required, the use of a special-purpose machine is still more efficient for the manufacture of small gears produced in high volumes. Therefore the Heller/Voith process is not directly aimed at classic contract gear manufacturers producing a small variety of workpiece types in high volumes.

Instead, the Heller solution is for system suppliers; e.g., manufacturers of vehicles, machines or machine components that can also use the machine for other machining tasks. The process will also be of interest to gearbox manufacturers, whose products also include complete assemblies. This applies in particular to large gears, since the machines and the technology provided by Heller are suited for a wide range of machining tasks and provide the additional benefit of enabling efficient machining of gears and bevel gears.

Kenneth Sundberg, global business development manager at Sandvik Coromant, considers this a very interesting market opportunity. "The recent past has shown that the market continually comes up with machining solutions for gear components and bevel gears. For this reason, Sandvik Coromant has modified standard tools and incorporated new developments in the milling cutters. We are extremely satisfied with the machining results achieved so far. In a second step, we will focus on hard-milling processes.

"Although it is possible to use solid carbide end milling cutters for this purpose, we and Heller believe that using special crown milling cutters and side milling cutters will provide higher productivity and economic efficiency," he concludes.

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Low Inertia, Zero-Backlash Gear

DESIGNED FOR TIMING CRITICAL APPLICATION

Intech Corporation was approached by a customer with a dilemma involving a new machine for corrugating paper products. The customer was attempting to maintain precise timing between two shafts with corrugating steel teeth to prevent them from smashing into each other. Intech focused on a backlash-free, low inertia gear design as the solution.

The traditional backlash-free gear design consists of two gears, typically spur gears, with one split in two halves. Once both gears are installed on the shaft, the two halves of the split gear are rotated manually in opposite directions until both touch the opposite tooth flanks of the wider mating gear, eliminating any backlash. The two narrower gears are then fastened together, usually by bolts.

The Intech zero-backlash design is based on the same principle of eliminating backlash by engaging the opposing flank of a wider gear with two halves of a split gear. The gears are helical, and instead of rotating the narrower gears around their axis, they are forced apart in an axial direction. This is accomplished

by a spring placed axially between the split gears, and cylindrical guiding pins that are securely anchored in the metal core of one of the narrower gears are fit into the counter bores machined into the all-plastic second half of the split gear. The spring force pushes the gears apart, and the pins force the gear to move axially to prevent any rotation.

The principle behind the design is that one-half of the split gear engages the wide gear on the load carrying flank, the front flank and the other half. These are guided by the pins to move axially and will be stopped by the rear flank of the second tooth blocking the axial movement with the helix angle. For the preload of the split gear in opposing direction, Intech relies on the elasticity of the Power-Core polymer material used. By designing all gears in the gear train with Power-Core, inertia was reduced in the drive by 65 percent.

When pressed against the helical flank of the wider gear, the tooth of the narrower gear will deform slightly to allow engagement along the full length of the flank. Both halves of the split gear, as well as the spring load, are calculated to develop enough preload for carrying the entire torque with enough safety to guarantee a backlash-free mesh, even during an emergency stop. Intech uses proprietary software to calculate expected gear life.

For installation and the preceding gear hobbing, the two halves of the split gear are fastened together with the provided bolts to form a helical gear. This gear is then installed on the shaft and meshed with the wider helical gear. The gear half of the split gear with the metal hub is attached to the shaft by a keyway and a key. Once the installation of all gears is complete, the fastening bolts are removed, and the spring does the rest. With this design, the backlash adjustment is automatic, as the spring pressure is permanent, and there is no need for manual readjustment when tooth wear occurs.

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ONLINE

Visit
www.geartechnology.com
for the latest Product News

ECM Process

DEBURRS INJECTION SYSTEM COMPONENTS

Deburring may not be a core process in machining, but it is still considered a necessary evil. Although other machining operations have been optimally coordinated, deburring is still not included in the process stream from the start, but EMAG introduces this capability with its Electro-Chemical Machining (ECM) process.

Workpieces with complex contours feature sectors that are note simple to machine because they are difficult to access. Undercuts, pockets and internal, overlapping bores present no major challenges to mechanical machining operations, but this can change when these sectors require deburring. The mechanical, thermal and waterjet-based technologies used up to now cannot guarantee intended output rates, economic viability and repeatability. Medium size and large batch production specifically require high component quality. Internal burrs and lugs can seriously affect this component function. When burrs are removed using standard machining processes, a secondary or "turned down" burr can form and leave further finishing to be needed.

ECM—unlike spark erosion—is a gentle, electro-chemical metal removal process that does not involve spark formations. An electrode is connected to a DC or pulse source to act as a cathode while the workpiece represents the other

electrode and is poled as an anode. The charge in the electrode gap between cathode and anode flows in a watery electrolyte solution (sodium nitrate or sodium chlorite, for example) and dissolves metal ions on the workpiece.

The material thus removed can later be filtered out from the electrolyte solution as metal hydroxide. The contour of the cathode is made to fit the machining requirement. This ensures that deburring, without causing mechanical or thermal stresses, takes place only at the point of the workpiece where it is necessary to remove material. This is where the main advantage of the process lies. This pinpoint machining process allows for the most delicate components to be deburred with high accuracy and repeatability.

It is important to define the machining direction from the start when deciding on the machining layout and the sequence of operations. If this is done, burrs can later be removed precisely and economically. The big challenge of the past was that deburring occurred at the end of the machining process. Using ECM, the whole machining process, including the interlinking of machines, will be performed from the start.

ECM is economically viable because as cycle times can be reduced and output rates increased in line with the number of components that can be accommodated in a single fixture, cycle times per component can be set at below 10 seconds.

EMAG's scalable power electronics allow for individual cathodes in a group of workpieces to be monitored separately for quality control. This ensures that the size of the charge in the solution and the volume of metal removed by each cathode can be monitored. ECM is wear resistant, precise and contactless.

ECM is enhanced by the PECM process. The P indicates precision that is

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achieved with a pulsed current, an oscillating cathode and pulse-packets. Quality depends on an efficient pulsed current source and a rigid machine. The ECM and PECM processes are used in the automotive industry, aerospace and the medical equipment industries.

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Measuring System

GOES WIRELESS

The MikroCAD Lite measuring system from GFMesstechnik is now available without a PC, so all data acquisition and evaluation is performed within the system's sensor head. This development in optical 3-D measurement was released at the Control 2010 show in Stuttgart, Germany.

Since the MikroCAD Lite is wireless and pre-programmed, there is less equipment and no set-up involved. The system consists of an optical 3-D sensor, a screen for viewing measurement data and a tool holder. It is appropriate for high volume production lines since

measurements are completed in less than two seconds.

The MikroCAD Lite measures complex geometries using a high resolution CCD camera and digital stripe projections to generate 3-D data in the one micron range. Measurable geometries include radii, angles, chamfers, chipping and wear along the tool edge.

For more information:
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Transmission Analysis

ADDED TO ROMAXDESIGNER

Design engineers are increasingly presented with more challenging scenarios, especially given automotive industry trends towards more efficient, quieter and higher performing vehicles. The need for confidence in simulation technology has never been greater.

Romax's latest release of *RomaxDesigner R12.7* delivers such confidence by offering a more in-depth level of analysis than ever before. The new edition includes advanced capabilities such as accounting for thermal expansion, test duty cycles, improved NVH, gear whine analysis and gear root stress prediction, as well as other features and improvements.

When designing transmissions, thermal expansion is a major factor, and users can now account for this with *RomaxDesigner*. The software calculates the thermal expansion for all components, enabling users to visualize how this affects the whole system at the same time as considering clearances, deflections and preloads. This capability considers the thermal expansion of shafts and bearings, as well as housings, planet carriers and other imported finite element components.

Testing of transmissions is an essential part of the design process, and *RomaxDesigner*'s capability for test duty cycle generation, users benefit from reduced rig testing times. *RomaxDesigner* generates a test duty cycle from road load data with con-

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densed damages. This matches for gear contact, gear bending and bearing damages within one duty cycle, reducing the need for additional testing time.

RomaxDesigner can perform a root stress analysis, predicting root stress due to gear mesh loads and system deflections. A critical gear performance parameter, users can calculate this in *RomaxDesigner* without having to resort to time-consuming and specialized finite element analysis. As the demand for NVH technology grows, Romax has improved the usability and robustness of all *RomaxDesigner* NVH functions, increasing the ease of use for customers. Another enhancement is the improved third party links and development into time domain based analysis software such as *ANSYS* and integration to other dynamic analysis packages.

For more information:
Romax Technology
www.romaxtech.com

Infrared Touch Probe for CNCs

OPERATES WITHOUT CABLE

The TT 449 tool touch probe from Heidenhain serves as the company's first infrared tool probe offering. Designed for use with numerically controlled machine tools, the TT 449 is appropriate for applications where unlimited movements are necessary, such as with tilting or rotating work or rotary tables or with five-axis machining centers. It will be on display for the first time in North America at IMTS in booth E-5131.

This infrared touch probe offers increased mobility without the need for a cable. For tool measurement and inspection right on the machine, it is a simpler alternative than the complex laser measurement systems common to a five-axis machine.

One benefit of the wireless infrared touch probe is that the unit can be placed anywhere on a work table. It is also possible for an operator to move and re-mount without the need to handle cabling. Once mounted and put into

operation, the disk-shaped contact of the TT is deflected, and the signals are transmitted to the control over an infrared light beam. The generated trigger signal is then transmitted via an SE 646 transmitter/receiver unit to the control, where it is further processed. The SE 642 can also be used for a spindle probe. The control ultimately saves the measured tool length and radius in the tool memory.

The Heidenhain TT 449 tool touch probe has IP 67 protection and continuous duty of 200 hours with a lithium battery. A rated break point protects the touch probe from damage due to operator error.

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Gleason

DELIVERS LARGE GEAR HOBS FASTER

With a major investment in equipment and processes, Gleason Corporation has optimized the manufacture of large module gear hobs. These cutting tools are used to manufacture large gears for wind energy, mining and various industrial gearbox applications. The Gleason

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Cutting Tools facility in Loves Park, IL can now produce hobs up to 450 mm in diameter, 530 mm in length and up to 40 module. Large module hob manufacturing lead times now range from 7–9 weeks. Gleason can produce DIN and AGMA AAA class hobs.

The multi-million dollar investment includes customized equipment with on-board inspection, fast change-over, accuracy and repeatability. According to Robert Phillips, senior vice president of Gleason's tooling products group, "This investment allows us to extend our global

leadership in gear cutting tools and serve the fast growing markets such as wind energy with the shortest lead times in our industry."

Gleason also has a Fast Track delivery program that has immediate delivery options available on some machines, including the Gleason-Pfauter P 1600, the Gleason 650 GMM Gear Inspection System and Gleason 1500GMM.

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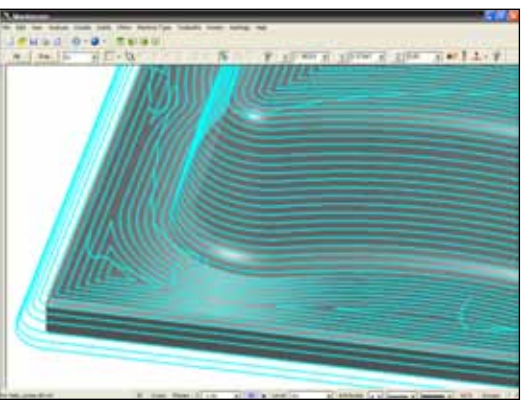
Mastercam X4

CERTIFIED FOR AUTODESK INVENTOR 2011

CNC Software, the developer of *Mastercam* CAD/CAM software, announces that *MastercamX4* CAD/CAM software has been certified for *Autodesk Inventor 2011* 3-D mechan-

ical design software by the Autodesk Inventor Certified Applications Program. To be certified, the product must meet certain guidelines and demonstrate a high level of quality, as well as compatibility with *Autodesk Inventor* software. Certification is given only after the product has been tested and approved.

"We are very happy to be certified for *Autodesk Inventor 2011*. Many *Mastercam* customers receive Inventor files, so both communities can be assured of the seamless integration between our two products," says Gary Hargreaves, director of business development for CNC Software. "The flow from design to manufacture becomes easier for both *Inventor* and *Mastercam* customers, where the designer can be assured that the part designed in *Inventor* is precisely the part that is machined with *Mastercam*. Both companies are working together to provide customers with the best in CAD and CAM software. The Mastercam and *Autodesk Inventor* integration offers users a way to easily work between the two products and stay ahead of their competition."



Mastercam X4 has a direct add-in for *Autodesk Inventor* to boost productivity. *Autodesk Inventor* mechanical design software takes engineers beyond 3-D to digital prototyping by enabling them to design, visualize and simulate products before they are ever built. Free to the *Mastercam* and *Autodesk* communities, *Mastercam Direct* allows users to open a model in *Mastercam* while in an Inventor session, and then update toolpaths to reflect changes to the model. *Mastercam X4* is able to read in native Inventor files for design purposes and toolpath generation.

"*Autodesk Inventor* software users can import part files and manufacture them quickly using *Mastercam X4*," says Tim Gray, director of Inventor product management at *Autodesk*. "Having partners, such as *Mastercam*, in the *Autodesk* Certified Application Program assures users that the same standards of product quality we want for *Autodesk Inventor*

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are being extended to the *Mastercam* suite of solutions."

Another new feature to *Mastercam* is the ability to open native *Unigraphics/NX* part or assembly files without a *Unigraphics/NX* license requirement using UG Read. UG Read allows users to import product manufacturing information data, such as properties, datums, dimensions, notes, geometric tolerances and datum targets.

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Artec Machine Systems

INSTALLS BEAD BLASTING BOOTH

The CrossFlow Booth is a drive-in paint and bead blasting booth installed by Artec Machine Systems. It measures 10 feet wide by 12 feet long and 12 feet in height, and it draws fresh air through filters installed in the drive-in doors. The clean, filtered air is pulled through the booth and then exhausted through an environmentally friendly filter system.

All external casings and covers of gearbox and component rebuilds Artec performs are now bead blasted clean by the CrossFlow Booth. The final finish includes a corrosion-resistant sprayed undercoat followed by an oil resistant top coat.

Artec, headquartered in North Branford, CT, supplies customized gear drive systems to various industries. It is the North American sales and service agent for Renk-Maag GmbH, Kissling AG and Euroflex Transmissions.

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