Gear Milling on Non-Gear Dedicated Machinery

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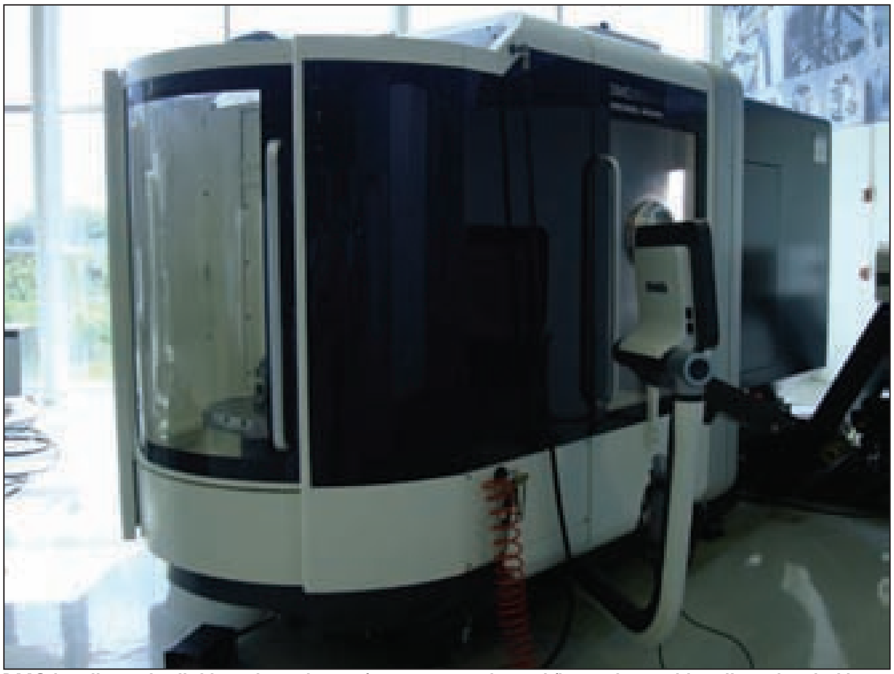
Imagine the flexibility of having one machine capable of milling, turning, tapping and gear cutting with deburring included for hard and soft material. No, you're not in gear fantasy land. The technology to manufacture gears on non-gear-dedicated, mult-axis machines has existed for a few years in Europe, but has not yet ventured into mainstream manufacturing. Deckel Maho Pfronten, a member of the Gildemeister Group, took the sales plunge this year, making the technology available on most of its 2009 machines.

The initial focus bringing this technology to market stemmed from increased demand for energy applications, wind primarily. Spiral bevel gears have been the most common type produced using these machines, but DMG is capable of manufacturing many other types as well, including internal and external spur gears, helical and double helical gears, straight and spiral bevel—both the Klingelnberg cyclo-palloid and Gleason types—and hypoid gears.

The potential exists to make most any type of gear using this method, but the technology is so new that DMG has not yet touched upon all the possibilities. They rely on the customer to present them with a blueprint to proceed. DMG has developed software for creating the 3-D data necessary for production of high accuracy gears.



DMG has the potential to cut any type of gear on a universal five-axis machine, though spiral bevels have been the focus (courtesy of DMG).

"We have developed very accurate, very specific software to calculate the tooth geometry," says Dietmar Haberlag, product sales manager for DMG America.

The gear milling software consists of several modules for design, CAM, simulation, measuring and training. DMG intends to have the components merged into one software package by EMO in October, at which time they also expect the interface to have a new, more user-friendly look, and an application for programmers. The concept for the software was prompted by some of DMG's customers who approached them with numbers and nothing more. "The idea was because not every customer is able provide the necessary gear design information data," says Albert Schäftner, team leader of the five-axis group for Deckel Maho in Germany.

The design module is a program for calculating the tooth geometry. It serves as an interface for gear data entry, designing fillet radius, defining gear backlash and profile correction and engaging simulation and collision monitoring.

The CAM module is responsible for defining tool geometry, creating roughing and finishing functions, and it serves as a post-processor for the five-axis machines. The simulation module replicates the part process. It represents the turning part geometry, provides gear geometry output, optical simulation of machine movements, optical collision check and analysis of working travels.

There are also optional modules for measuring and training. The CMM module measures data output in Deckel Maho format; other formats are possible by request. The training module offers startup, process and technological support. DMG is currently offering extra support for customers in order to cut the learning curve. They plan to make improvements based upon customer feedback and requests.

"Gear experience is not our technical expertise," Schäftner admits. "We have to rely on the customer for [this] knowledge. That's how we approach our goals."

The gear milling capability is not a retrofit option, although this may be a possibility in the future. Most of Deckel Maho Pfronten machines will be equipped for cutting gears with a

Most new DMG machines can be equipped with the gear milling technology (courtesy of DMG).

few standard options, such as a B- or A-axis, touch probe, Blum laser and 3-D quickset.

This technology essentially launches DMG's entry into the gear market, but they do not have any illusions about where they stand competitively with the industry's big machinery players. Haberlag is quick to draw a distinction between what DMG is trying to do with this technology as opposed to what a Gleason or Klingelnberg does.

"We are doing this on a five-axis machine, which is different to that which a main manufacturer like Gleason or Klingelnberg is doing. They are making this on a special purpose machine. We are doing this on a multi-tasking machine. This means on that machine you can make a turning process, you can make the milling, drilling, the tapping process and gear finish machining process in hard and soft material condition," he says.

"We are not so much in the field of mass production. We are more for multiple model types, less batch sizes, for very large parts. We don't take their business away; however, we are offering a much higher benefit in many fields."

The biggest appeal to manufacturers with this is that it provides them with the capability to use a machine to cut gears and other parts as well. So there is much more flexibility for manufacturers that produce parts that include but are not limited to gears.

"Gleason and Klingelnberg are only in the field of gear machining," Haberlag says. "We are in a very wide field. Gears are just a small part of our business. We are trying to get more because we are seeing particularly in the field of wind energy, spiral bevel gears, larger gears. It is much more economic to make them on our universal milling machines than on standard gear machining models. The idea is to use a five-axis machine with standard tooling and all the features of a machining center or universal mill-turn machine.

"Klingelnberg or Gleason, they need special tools, very expensive, very long delivery and only for this particular gear profile."

The consensus among some gear makers is that the technology is new and in an experimental stage, but there is definite potential for the industry.

Louis Ertel, president and CEO of Overton Chicago Gear, takes a cautious, wait-and-see-stance. "It's all a question of how fast they can do the machining and how accurate and how good the surface finish is," he says.

For Larry Delp, manufacturing engineer for Fairfield Manufacturing, "The size of the machines that we have or they are capable of producing would be of interest to us.

"[The larger equipment] would give us some larger capabilities for bevels,

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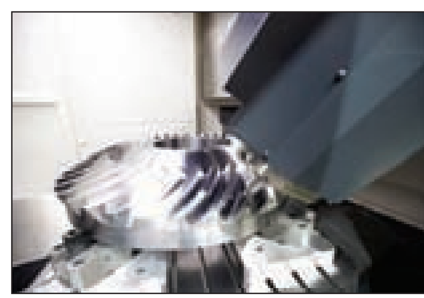

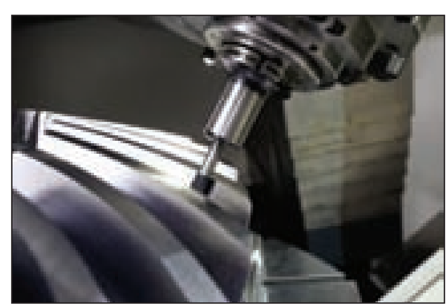

also hard-finishing capabilities. Also you get big parts that have hubs or areas that a face mill-type cutter wouldn't be able to go through, so you can do some things a regular bevel type machine can't do," Delp says. "It's interesting. Looks like it has a ways to go on the technology and maybe the software, but I think it has certainly got potential."

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