

## Machine Controls

*The new Heidenhain TNC 640 CNC offers machinists dual-function milling and turning with software to enhance precision machining.*

# Pumping Up CNC Productivity

*With new mill/turn-capable CNCs and improved software, the latest machine controls boost manufacturing efficiency*

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To compete in the fast-paced world of manufacturing, machinists look for no-compromise machine controls offering fast, precision programming of machine tools. The latest CNC systems from machine control developers include a new dual-function milling and turning control and several updated controls with embedded software routines that can significantly speed up CNC programming.

With the popularity of multitasking mill/turn machine tools rising, controls developer Heidenhain

Corp. (Schaumburg, IL) at IMTS introduced to North America its new TNC 640, a new dual-function milling and turning control that boasts a host of advanced features for programming complex mill/turn equipment. "It's becoming a more prevalent trend in machine tools, saving money and time on fixturing and multiple setups," said Chris Weber, national sales manager, Machine Tool Division, Heidenhain Corp., of multitasking mill/turn machines. "We wanted to take to market a very stable product. Not a lot of people are aware but we do make quite a number of turning controls. So the question was adapting turning cycles into the milling hardware platform, consolidating everything and making a seamless integration."

### Interactive CNC Programming

Heidenhain's TNC 640 was designed from the start as a dual-function control capable of milling and turning, Weber said, either at the CNC or by using off-line programming, depending on part complexity. "It's specific to purpose. There

are a lot of dedicated machining controls," Weber said. "We have a lot of user cycles on both the milling and turning side in the 640. I don't think anybody realistically is ever going to program five-axis [parts] at the machine. But you want the ability to edit the program, make changes, and visualize the part through interactive programming graphics and graphical dry runs. We have the mechanism to do interactive programming on the shop floor via cycles; they're there for a reason."

Today's CNCs offer substantially more software content than in years past, as control developers offer features that help speed precision machining, improving ease-of-use as well as part finishes and overall productivity. "In terms of functionality and overall capabilities, it has increased incredibly so," Weber said of programming directly at the control. "As parts become more complex, and as machines and operations become more complex, new software routines and subroutines are developed to enhance and complement these capabilities."

With the TNC 640 control, turning operations can now be enabled on a milling machine allowing the operator to easily transition from milling to turning cycles in the same program. Turning operations can be programmed in plain text, just like familiar milling operations, and comprehensive turning cycles are available for frequently repeated operations, such as roughing, finishing recessing and thread cutting. The 640 CNC is based on the Heidenhain Serial Controller Interface (HSCI), the company's new, completely digital interface hardware platform, and it features an ergonomic design with a 19" (483-mm) screen, a stainless-steel front operating panel, and a specially prepared keyboard surface and screen frame to eliminate fingerprints.

Two features for improving machining accuracies and part finishes, especially for five-axis machining, are Heidenhain's KinematicsOpt and KinematicsComp, Weber said. With the KinematicsOpt feature, which uses a calibrated sphere and a touch probe, machinists can account for dynamic changes in kinematics of the machine tool and calibrate the rotary axes. With the newer KinematicsComp, which Weber says is more of a builder option, Heidenhain controls can perform 3D volumetric compensation to further improve machine tool accuracy.

Heidenhain added another new function, Active Chatter Control (ACC), that allows the TNC 640 to dramatically improve part finishes during heavy cutting without slowing down. "If I'm taking a heavy cut at a high feed rate, I can set up a certain harmonic or a frequency in the machine tool based on the number of teeth that come into contact with the workpiece, and it's going to create a resonant vibration," Weber said. "Typically the way to counteract that is to slow down your feed rate.

"Chatter is vibration and it's manifested as noise. You can hear chatter," Weber added. "With our Active Chatter Control, you no longer have to slow the feed rate down because we can actually compensate for that chatter. It's manifested in two ways—you don't hear that noise and you don't see the marks on the part. You get a better surface finish, and you didn't have to slow down to achieve it."

### Make It Conversational

Easier-to-use CNC technologies rank high among machinists that need to quickly perform programming on complex machinery. Diversity in programming options by offering optional conversational programming capabilities is key for many users, notes Todd Drane, marketing manager, Fagor Automation Corp. (Elk Grove Village, IL).



Photo courtesy Fagor Automation

**Fagor Automation's 8070 CNC allows operators to easily switch between conversational programming and traditional G-code programming modes.**

"With today's control software, we give the customer the option of which programming format they desire to utilize based upon their own skill level and application," Drane said. "This can be individually chosen from operator to operator; if one programmer/operator has spent his career mastering ISO G-code, he can do all of his work in that mode. If the next operator is new to CNC and would prefer a simpler format, he can simply press two keys that switch the CNC to a conversational programming format."

Another feature on Fagor's CNCs allows an operator to use a sophisticated tool inspection mode in which the machin-

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ists can stop the program, withdraw the tool, and inspect or modify as needed, Drane noted. “Without changing screens, users can modify the tool offset and automatically reposition to the point in the program where it was interrupted, then continue on within the program with the new offset active,” Drane noted. “He even has the ability to retrace backwards through the program, which is a useful resource for tool-breakage situations. These features are created with only one thing in mind, efficiency. Rather than a complete program stop and restart, machinists are able to interactively make necessary modifications while in-process.”

Other key trends in CNCs today include newer advanced volumetric compensation capabilities, he added, where all degrees of motion are intelligently compensated, and other advancements with in-part gaging, collision detection and nanometric positioning resolution. “The real trend is refining the speed and performance of a machine tool to provide the customer with the best possible performance,” Drane said.



Photo courtesy Siemens Industry Inc.

***Aimed at job shops and retrofits, the new Siemens Sinumerik 808D entry-level CNC offers a cost-effective upgrade path for two- and three-axis knee-mill style machine tools.***

Faster processing on today's CNCs gives operators the ability to micro-manage the machining process in real time, he added. “In the past, a servo command was presented to the drive, it would begin its execution, the CNC would read the position as provided by the encoder and then update the servo with a new command. Nowadays, this process seems almost cryptic,”

Drane stated. “We now anticipate the position and modify it hundreds of times per second, via servo control techniques that modify not just based upon the programmed feeds and speeds based upon the reported encoder position, but also with the machine dynamics, such as cutter load, ambient temperature and programmed contour taken into consideration.

“Different manufacturers call this different things, but we call it HSSA [High Speed Surface Accuracy],” he added. “HSSA will anticipate conflicting areas of the executing program and automatically smooth the transitions, while always following the machining toolpath. At the same time, algorithms are developed for smoothing the profile, while cross confirmation is done with the axes in respect to jerk control and the multiple acceleration/deceleration curves when the movement of the rotary axes requires a better response than the linear axes. This is an example of a new CNC feature that helps improve precision and part finish.”

### **CNC Retrofits**

Aiming for job shops and retrofits, CNC developer Siemens Industry Inc. (Elk Grove Village, IL) at IMTS introduced its new Sinumerik 808D, an entry-level CNC for retrofitting knee-mill-style machines for milling and turning applications. Siemens also brought out a new mid-range control, the 828D Basic, that fits between the company’s 828D and flagship 840D sl CNC.

“The 808D is more for the knee-mill-style retrofits, on machines that traditionally have the Anilam or Bridgeport controls on them,” said Randy Pearson, manager, end-user support, Siemens Industry Inc. “People are having issues getting them fixed and repaired, because it costs them more to fix those controls than a new 808D control with drives and motion would cost. One of our dealers

told me that to get a Bridgeport EZ Path control fixed today, they’re looking at upwards of \$6000 to fix it, because they don’t make any parts for it so they all have to be repaired. A two-axis retrofit is less than the cost of repairing that unit.”



To save costs, most retrofits on two- or three-axis machines leave the existing spindles in place, Pearson noted. “That way they don’t have to do a massive, full strip-down and rebuild of everything. You can use some of the existing components,” he said. “Some of the guys are looking at using the existing cabinets, and the control arms, and just mounting their stuff in there so it cuts costs.”

The new Sinumerik 808D targets the highly competitive, high-volume 230-V, three-phase and economy machine tool market, offering up to three-axis plus spindle control capability in milling or turning. The CNC is offered as a package with Siemens Sinamics drives and Simotics motor solutions. At IMTS, Siemens showed the 808D on a knee mill. With an embedded Linux operating system, the 808D’s standard features include a 7.5" (191-mm) LCD color display with 640x480 resolution, selectable function keyboard, rotary dials for speed and spindle override, LED tool number display, durable buffer battery and rear connection ports for USB, RS232-C, distributed and on-board I/O, setpoint to feed axes and spindle, a spindle encoder, and fast I/O for probes and handwheel operation.

The control also features 80-bit nano floating point accuracy and intelligent jerk limitation for smoother path cutting and less mechanical stress on the machine structures, helping performance whether a machinist is turning with a C-axis changeover or milling mold sections where path control is paramount. Featuring the new Sinumerik Operate interface, the control is very easy to use and set up. “This is as close to plug-and-play as you’re going to get out of the box,” said Pearson.

“You could do a retrofit on those machines with an 840 or an 828, but the cost is going to be prohibitive. The 808D also has the same interface, so navigation and programming is the same, everything is pretty much the same across the board on all the controls now,” he added. “If you have a machine with an 828 or an 840, you’re going to say that this control looks exactly the same as our other machines, so people can pick up the training on it a whole lot quicker, with the continuity of the Sinumerik Operate interface.”

### Automation Options Widen

As demand for general motion applications has grown, CNC developer Fanuc FA America (Hoffman Estates, IL) has targeted new controls, like the Power Motion i-Model A motion control introduced at IMTS, aimed at a wide range of general industrial applications including stamping presses, brake presses, printing, and in plastic injection molding presses.

“We’ve been focused on developing optimal solutions for general motion, our new Power Motion i-Model A and the existing 35i control fulfill the needs of this market,” said Paul Webster, CNC engineering manager, Fanuc FA America.

“These controls are tailored more towards general motion versus CNC machining. The Power Motion i-Model A takes advantage of the same reliable hardware as our CNC, but there’s no spindle control. It’s not made for machining applications—it’s specifically for a motion-control applications.”

Automated loaders, gantry systems, and printing presses are applications that need more precise motion, Webster noted, as well as automotive stamping presses, molding, and conveyor systems that need higher accuracy. “We’re seeing demand for automation equipment that ties into the CNC and ancillary equipment that is sometimes integrated into a machining line that might have traditionally used a PLC. Traditionally, a machining center was a silo—it was all by itself. That’s not the case anymore,” added Webster. With overall growth in automation options, manufacturers are adding robots or loaders, and other automation. The new Power Motion



Photo courtesy Fanuc FA America

**A general motion controller from Fanuc, the Power Motion i-Model A, features control of up to 32 axes for robot loaders, gantry systems, automotive stamping presses and plastic injection molding press applications.**

controller is made for use with a gantry system or robotic automation for load/unload applications at machine tools.

In the Power Motion i-Model A, users get a control with multiaxis and multipath functions that features a maximum of four control paths, 32 total control axes, and four simultaneous control axes. The control is also said to be optimal for applications with large servomotors—up to 10 large servomotors in one CNC. The control has a pressure and position control function for presses.

“It’s for the people that are used to CNCs, and it’s a way for them to do automation without having to get familiar with PLC environments,” Webster added. “The people who build machine tools are already familiar with Fanuc CNCs because that’s what they use on their machine. When they move into the loader automation equipment, they’ve got a choice of using something like a PAC or a full CNC. Well, a full CNC is overkill, and they might not be familiar with a PLC environment. What we’re offering them is what we call a power motion, which is that bridge equipment.” **ME**

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