CNC systems unleash greater control for manufacturers

Chris Warner, Executive Editor

Computer numerical control (CNC) has become an indispensible part of the industrial landscape for the past few decades. Used for the production of everything from medical instruments to wind turbines, these devices are characterized by extreme accuracy, precision and very high repeatability. Not only have they reduced the human factor in machining and in turn the costs and errors that go along with it, today’s CNC machines – thanks to their reliance on computer-aided design (CAD) and computer-aided manufacturing (CAM) programs –have even relieved the CNC operator of many tedious and repetitive tasks, freeing them up to do other tasks such as maintenance and quality control.

Due to advancements in motor control, sensing technologies and human machine interface (HMI), today’s digital CNC systems provide all the accuracy that manufacturers demand along with the flexibility and scalability needed for very exacting applications. CNC vendors also have the future needs of their users in mind, designing in higher levels of customization as an increasingly important benefit.

More axes mean more precision for complex tasks

It’s all about motion with CNC systems, and the more axes of motion a system can handle means greater capabilities in addressing more complex machining tasks. Five-axis milling capability, along with intelligent motion control, is the standard for leading edge CNC technology. One of the latest advancements in five-axis technology is real-time transformations without the need for a CAD/CAM post processor.

Ryan Legg is a product marketing manager at Siemens. According to Legg, advancements in five-axis technology, such as transformation orientation (TRAORI) not only offers precision results for complex tasks, it simplifies the process.

“All part programming is in relation to the tool center point. This allows the same part program to run on various machine tool kinematics and drastically reduces the amount of data required to be transferred from the post processor.” He adds, “parts with complex contours such as blisks and impellers require a control with five-axis machining.” Legg goes on to say this accuracy enables greater control of very highly sophisticated tools such as multi-channel machines that run up to 93 axes simultaneously and 10 channels simultaneously.

A number of different motors are used for handling different parts, and the drives are becoming more modular in order to provide more flexibility in configuring the system. You’ll find three-phase feed motors, torque motors, linear motors and spindle motors to suit a variety of applications. Increasingly, the drive interfaces of CNC systems are opening up to multiple manufacturers. This eases integration, and it satisfies the customer, as well as the third-party manufacturer.

In addition, CNC vendors are now offering drives that have a low moment of inertia. This leads to excellent dynamic response. Advanced, two-loop cooling systems help

the motors reach higher velocities and, in the case of the SINAMICS linear motors in the Siemens SINUMERIK 840D sl, 300 m/min and accelerations of up to 45 g are theoretically possible. The 840D sl has a particularly unique design for its three-phase main spindle motors – the motors are shrunk directly onto the motor spindle. By removing several mechanical components, the one-unit design can achieve high power density, and speeds up to 40,000 rpm – which conventional spindle systems typically cannot achieve – for very demanding applications.

A high degree of flexibility

CNC systems are increasingly designed to offer the manufacturer flexibility and scalability, to meet customer requirements that range from basic positioning tasks all the way up to systems with multiple axes, and to meet the future demands. The more flexibility afforded the manufacturer, the more unique the machine.

The SINUMERIK 840D sl from Siemens, for instance features an open control architecture, unlocking users from their reliance on a single supplier’s products. Ryan Legg explained that the 840D sl includes multiple processors for numerical control and the PLC within the numerical control unit (NCU). Its software, meanwhile, “can be embedded in the NCU or a PC unit (PCU) can be added to the system for the system software to reside on.” Legg adds that “the PCU solution is best for customers who require a Windows environment for a complimentary application. It is certainly not necessary though, even if the customer is developing custom screens. They are able to run on the embedded platform just as easily as on a PCU.”

In the HMI, machine tool manufacturers increasingly have more freedom to adjust

the interface for custom applications. An open system is highly scalable and can be comprised of small handheld units or the largest of operator panels.

According to Legg, additional benefits of an effective HMI system includes a platform that allows for simple implementation “right out of the box”, as well as the flexibility to be customized. This means compatibility with software tools that allow for adding one simple, additional screen for a particular OEM, to more advanced tools that allow for a completely redesigned HMI, and everything in between. Siemens uses a Windows-based, menu-driven editor that lets users modify the interface to optimize the controller to the manufacturers’ specialties.

Kernel is critical for custom control

The key to the SINUMERIK 840D sl’s open control architecture is the numerical control kernel (NCK). According to the company, it allows user-specific configuration of system cycles and function macros using standard operating tools. This is particularly useful in, for instance, the development of handling special machine kinematic designs. Legg points out that “usually customization of a CNC ends with the HMI, but Siemens takes it to this level in the NCK.”

As the industrial environment continues to evolve, already-demanding machining tasks will continue to add complexity. With the increased complexity, the best computer numerical control systems will be those that are defined by the customer. CNC vendors are responding with systems with more axes to meet exacting applications “head on” along with more modular drives to simplify system configuration, interfaces that are easier to modify for each customer, highly scalable hardware and software, and architectures that are truly open to each OEM’s own specialties. Look for these “customer-specific” systems to gain the most adoption across a wide variety of industries.

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