The NX CAM-SINUMERIK advantage

SIEMENS

White Paper

Optimizing the connection between CAM software and your machine tool controllers

To get the best performance out of today's advanced machine tools, your company needs to maximize the performance of its CAM software and the controllers that drive them. The optimized connection between Siemens PLM Software's NX™ CAM software and Siemens' SINUMERIK controller enables you to get the most out of your machine tool investments. This white paper discusses how you can take advantage of the NX CAM-SINUMERIK connection, which is especially valuable for enabling advanced machine tools to perform complex machining efficiently.

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Executive summary

The first objective of an optimized connection between a CAM system and a controller is to get the best performance from the machine tool's most highly valued capabilities. The second objective is to make those capabilities readily available as soon as a new machine is purchased.

By enabling you to purchase tightly integrated CAM software and controller expertise from one company, Siemens is able to offer an optimized CAM-CNC connection that works with all of the many machines capable of adopting a Siemens SINUMERIK controller. This optimized CAM-CNC connection is especially flexible since many of the key functions that facilitate maximum machine performance are controller-specific capabilities, which often are independent of the machine's make.

The tight connection between NX CAM and the NX postprocessor makes it possible for you to automatically adjust CNC output on the basis of a wide range of NX machining parameters. Additional NX CAM menu options allow programmers to selectively refine the automated output generated by NX CAM and its optimized SINUMERIK postprocessors.

Just as importantly, you extend the value of the NX CAM-SINUMERIK connection by using the SINUMERIK controller's core software to drive integrated 3D model-based machine tool simulations. "Controller-driven" simulation is much more effective than the generic approaches of other CAM vendors, which only emulate the SINUMERIK controller and approximate the motion of the real machine tool.

Siemens is the only company that offers both a major CAM system and an industry leading machine tool controller. Siemens PLM Software's NX CAM is one of today's most well established CAM systems, providing a wide range of capabilities in NC programming and machine tool simulation. Siemens Motion Control, which builds the SINUMERIK line of machine tool controllers, has an international market presence and reputation for facilitating high performance and complex machining, offering advanced machining technology and delivering highly effective job shop applications.

Today's challenges

Need for an optimized CAM-CNC process chain

It is frustrating and costly to have a new advanced machine tool and only be able drive it like a simple machine. Unless you are making simple, prismatic parts, or you have really experienced machinists who can work miracles with hand programming, you need a CAM system that can create part programs that match the capabilities of your advanced machine tool and its controller. When you buy a new machine and controller, you want to be sure that the critical parts of the CAM-CNC process chain are in place or readily available. If not, your existing CAM system or its postprocessor may not be suitable for your requirements and it could take weeks of lost production on the new machine before you solve this problem.

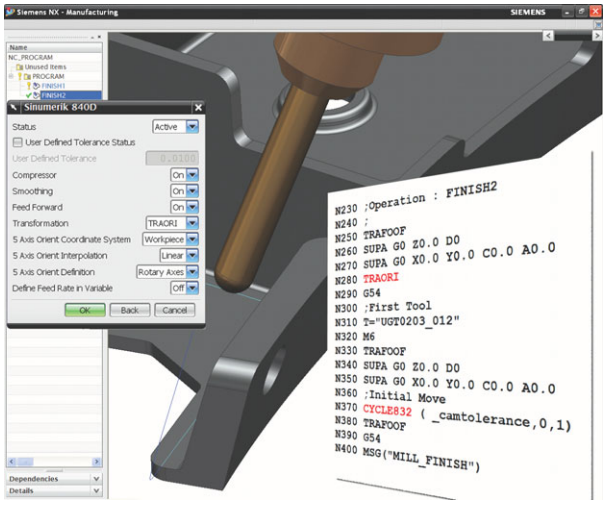

Figure 1: You can set the SINUMERIK controller options directly within the NX CAM user interface.

Dedicated CAM software for specific machine tools

To address the need for optimized CAM-CNC connections, some CAM system vendors and machine tool OEMs have joined forces to offer combined solutions. This allows them to offer very specific solutions that are set up just for a particular make, model and configuration of machine. However, this approach only works if the make and model of your machine, or the machine you intend to buy, happens to have the built-in CAM system.

Value of a CAM-to-controller connection

The advanced functions of the Siemens SINUMERIK 840D controller are equally valid on a wide range of different machines (i.e. different models or makes) that offer the SINUMERIK controller. As a result, if a CAM system can provide optimized output for the SINUMERIK controller, then this advantage is available to all of the machines whose models and makes offer SINUMERIK as an option. Accordingly, this kind of CAM system is much more cost effective and more valuable since it can be used by many more shops and many more machines.

Supporting other controllers

To optimize the connection between NX CAM and the SINUMERIK controller, Siemens PLM Software provides special capabilities within its existing NX CAM system. In addition, all of the optimization's core functions – from NC programming to G-code driven simulation – are available to support other controller makes and the machines that offer them. The close association between the CAM software and each controller's technology development leads to a better understanding of the way in which controller systems work with CAM data regardless of the particular controller in question.

For example, uniform point distribution technology is added to NX CAM based on a deeper understanding of controller and machine interaction. This functionality, which is now reflected within the standard NX CAM software, provides a direct benefit to any milling finishing operation regardless of the controller make.

Figure 2: Uniform point distribution (top half of block) results in better surface finish compared to points distributed "out of step" on adjacent passes (bottom half of block).

The NX CAM-SINUMERIK advantage

A key objective is to make sure that the advanced options available on the controller are utilized effectively to support each machining operation. A range of special SINUMERIK codes or cycle commands can be selected with the correct parameters for maximum productivity and performance at the machine tool. With the SINUMERIK controller, you can use the CYCLE832 command to prioritize speed, accuracy and surface finish to match specific machining operations.

Automated output

Ideally, you need the CAM system – and including its postprocessor – to set the optimized output for the controller and machine configuration as automatically as possible. The CAM system holds a wide range of information that is directly relevant for determining which controller options should be set for optimum performance.

During NC program generation, the tightly coupled NX CAM-SINUMERIK postprocessor can directly access the NX CAM machining system to check conditions that require certain settings in the optimized postprocessor output and to generate optimal SINUMERIK NC program statements. As a simple example, the roughing, semifinishing or finishing operation type can be used by the CAM software to automatically drive a basic selection of speed, accuracy and surface finish settings using the CYCLE832 command.

The system is also driven by a precise knowledge of the target machine, its configuration and kinematics. For example, when the postprocessor recognizes planar milling operations on different planes with fixed rotary axes on a 5-axis machine, it will automatically generate a CYCLE800 command with the appropriate values. However, if the rotary axes are variable, it will generate a TRAORI command to enable full 5-axis machining.

Manual selection by the NC programmer

In some cases where user experience or special flexibility is required, you may want to offer the NC programmer additional manual control. For these cases, the latest versions of NX CAM offer additional menu options that are available when a SINUMERIK-controlled machine is selected as the target. The following examples are menu options that have been introduced into NX CAM to select Siemens SINUMERIK controller functions. Many of these options can be set either manually or automatically or with some combination.

Compressor Converts linear moves into a smooth spline curve for fluid movements and excellent surface finish.

Smoothing Influences the path control by switching corner rounding on/off.

TRAORI Defines the orientation transformations that enable simple 5-axis tool path programming independent of the machine tool kinematics (the SINUMERIK 840D has unique programming functions that reduce the complexity of 5-axis programming).

CYCLE832 Presents optimum parameter settings for performance, finish and accuracy.

Frame command – CYCLE800 Makes it easier to program complex work pieces (when used in conjunction with swiveling tools; the SINUMERIK frame concept enables shifting, rotating, scaling and mirroring of coordinate systems).

Drilling, boring, tapping and threading cycles Provides NC programmers and machine operators with a high-level NC programming language that is easily understood; also enables machine operators to easily select, display and modify cycle parameters at the machine tool using the SINUMERIK program editor (a SINUMERIK postprocessor maps each drilling, boring, tapping and threading operation to its respective SINUMERIK cycle).

Postprocessors for specific SINUMERIK-controlled machine tools

Additional SINUMERIK options are available in the latest versions of NX CAM and the optimized SINUMERIK postprocessor functions are captured in a set of postprocessor templates. This makes it is fast and easy to build a new postprocessor for a specific SINUMERIK-controlled machine tool and set up special output codes to utilize advanced SINUMERIK functions. Many companies selected the SINUMERIK controller option over other controllers because of these advanced functions. Being able to use them immediately is important since it maximizes the value of your new machine tool.

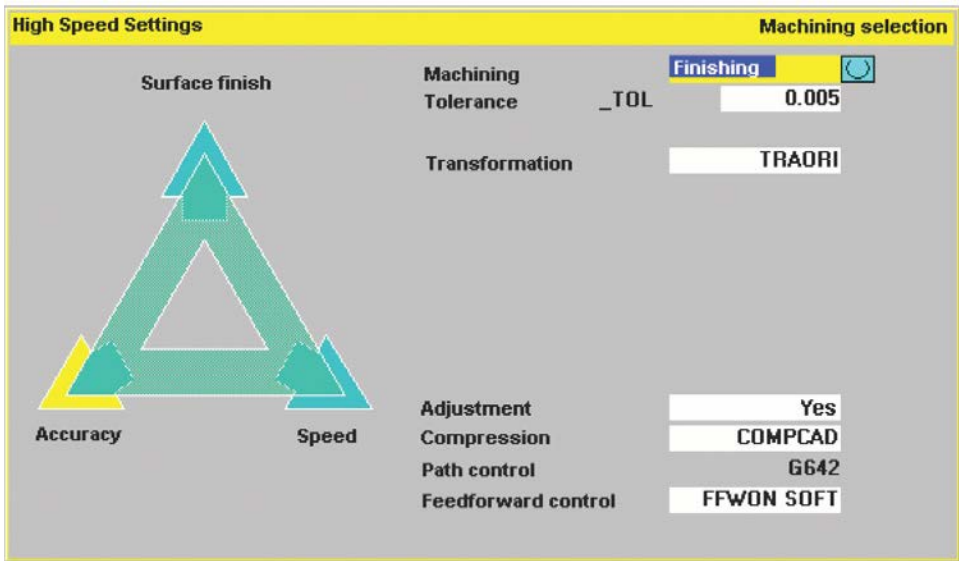

Figure 3: SINUMERIK 840D high-speed cutting settings are automatically set via NC file output generated by the NX CAM postprocessor.

The NX CAM-SINUMERIK advantage

Postprocessor editing

NX CAM is supplied with NX Post Builder (the system's own postprocessor editing application), which is built into the foundation of every NX CAM and CAM Express package. NX Post Builder can be used to build new postprocessors. In this case, you select the SINUMERIK postprocessor templates as a starting point to build your own postprocessor.

You can use NX Post Builder to easily edit a postprocessor, add special headers or comments, or make customizations to suit a particular requirement. NX CAM-SINUMERIK postprocessors are built for immediate use. However, you can edit them using NX Post Builder.

Controller-driven simulation

Controller-driven simulation is another advantage you can derive from the NX CAM-SINUMERIK connection. Unlike most other systems, the SINUMERIK core controller software is setup to run on a PC architecture. This makes it possible to take the core SINUMERIK controller software and use it to drive 3D machine tool simulation models inside NX CAM.

In most CAM systems, simulation either runs from pre- and postprocessor data or it uses software, which will attempt to emulate the controller in interpreting G-code. For complex machines, it's far better to run the simulation from the postprocessor output if you want to check the NC program.

By using the real controller software to read the postprocessor output and drive the 3D model-based simulation, you have an even more complete simulation. The Virtual Numerical Controller Kernel (VNCK) provides controller core software that you can implement as an add-on option to the NX CAM simulation software.

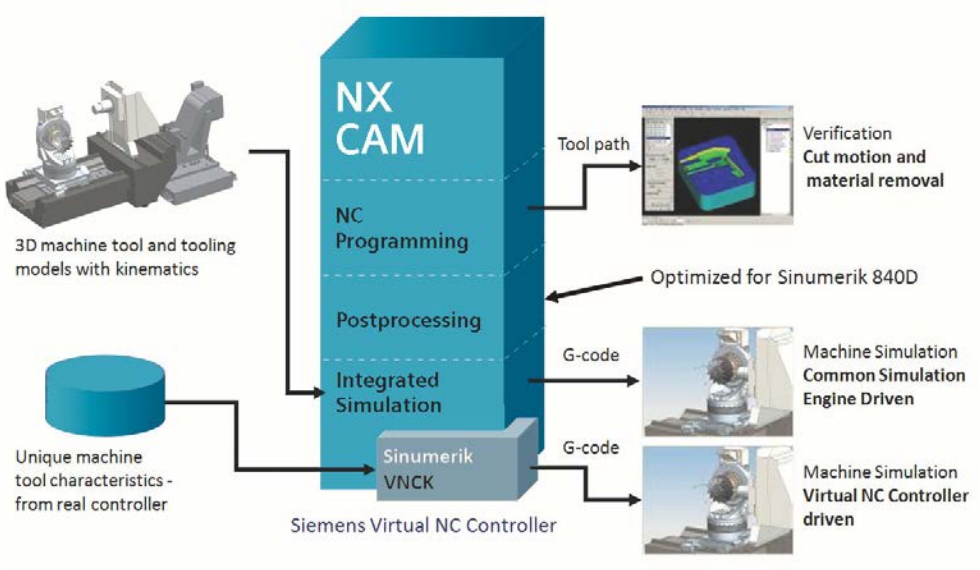

Figure 4: Controller-driven machine tool simulation provides the closest possible digital representation to actual machine tool motion.

About Siemens PLM Software

Siemens PLM Software, a business unit of the Siemens Industry Automation Division, is a leading global provider of product lifecycle management (PLM) software and services with 7 million licensed seats and more than 71,000 customers worldwide. Headquartered in Plano, Texas, Siemens PLM Software works collaboratively with companies to deliver open solutions that help them turn more ideas into successful products. For more information on Siemens PLM Software products and services, visit www.siemens.com/plm.

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