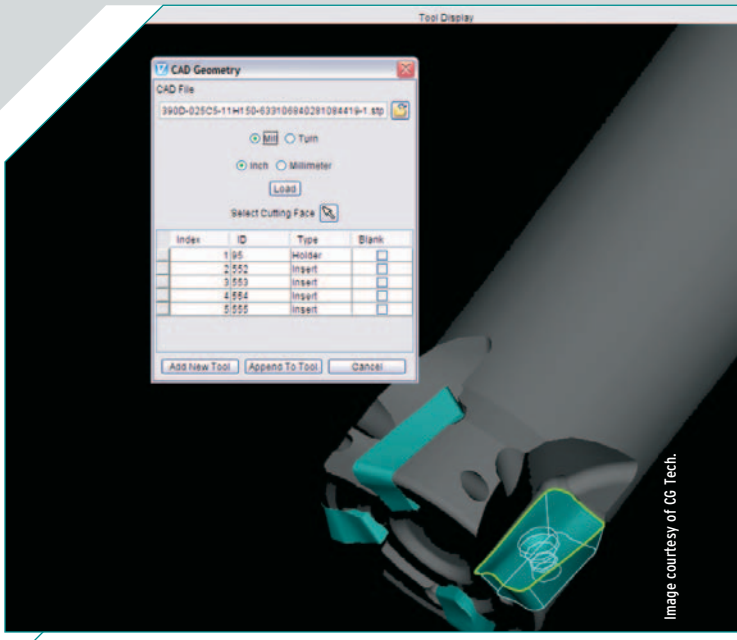
By Bryan Jacobs

Using Simulation Software to Tackle Complex Moldmaking Challenges

A look at trends and challenges facing moldmakers that have driven software enhancements, and considerations for simulation software selection.



CAD solid models of inserts and holders can be imported to quickly build a tool library for simulation. A CAD geometry window, shown in the image, allows easy identification of which parts of the CAD model file correspond with holders, cutters or inserts.

As machine tools and mold designs become more complex, part program verification using CNC machine simulation becomes an essential tool for ensuring that the moldmaker's NC programs machine the mold correctly the first time. Skipping the verification step creates costly production delays, which cause the machine tool to wait idle while the NC program errors are corrected.

To be truly effective, CNC machine simulation software must interactively simulate and display the material removal process of a NC program. NC programmers use software to verify the quality and accuracy of their NC programs while 3-D simulation of the CNC machine checks for collisions. However, the goal of simulation is not simply a collision-free and efficient NC program. The first and most important goal is a NC program that produces the correct workpiece.

Reducing the time required for moldmakers to easily develop, analyze, inspect and document the CNC programming process is an additional simulation software objective. Moldmakers should look for software that creates an in-process model can help them determine whether or not the NC program will make a correct mold. For example, many NC programs use circular interpolation. In order to measure the cylinder as an as-machined feature, the software must emulate the circle motion. Most internal simulations do not emulate circle motion, but instead divide the circle motion into a series of linear motions approximating the cylinder. These segments are not measurable as a cylinder.

Moldmaking Trends and Challenges: More and more moldmakers need to simulate specialized processes and complex machines. When a specialized process reduces production time or increases reliability, it becomes adopted by more companies. If a software developer supports simulating these special processes early, it instantly supports the next customers who adopt them. For example, years ago it was rare to see a NC program utilizing local part coordinate transformations and tool axis vector programming. Now it is fairly common.

Adoption of complex machines is similar. Not many years ago, 5-axis machines were rarely used by moldmakers. Today, more multi-axis milling machines are being used for moldmaking previously done using simple 3-axis milling machines. This trend has been fueled by a significant decrease in the price of multi-axis machines. Even small and mid-sized mold shops that previously would not have considered buying a 5-axis milling machine, now have to learn how to set up and program these machines; accurate 5-axis NC program verification and machine simulation becomes a mandatory tool.

While moldmakers benefit from significantly fewer required setups, the chance for collisions among machine components, tools and parts is very high. Complex machine tools typically involve many moving parts—often moving simultaneously, in a small space, at very high speeds, very close to an expensive workpiece. Also, the machine parts themselves are expensive and can have a long leadtime if they need to be replaced due to a

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collision. Wrecking a high-speed spindle can ruin more than just a moldmaker's day, but the effort required to manually validate a NC program that drives a highly complex machine is impractical. Significant software enhancements were necessary to support these complex machines in their early introduction.

Overall simulation time is an important consideration in every software purchase. Simulation software must be constantly evaluated, and the developer must regularly invent new algorithms to improve speed. Additionally, to further simplify setting up a simulation session, tool libraries should be created by importing CAD solid models of inserts and holders. This makes it simple to specify which parts of the CAD model file correspond with which holders, cutters or inserts.

CNC simulation and verification software has been continually updated. However, as more features are added, added complexity is inevitable. Some developers have ensured that the design and user interface is regularly refreshed, focusing on how it can better fit a modern mold manufacturing environment.

In some newer releases, the user interface has a more natural sequence to common user actions. Using a top-down flow through a graphical tree layout, context sensitive choices appear as the user moves along the NC program simulation process. Setting up a new project and running a simulation session becomes very intuitive.

Also developers have spent thousands of hours optimizing simulation methods, thereby creating the fastest, most efficient motion simulation to date. As a result, the moldmaker can spend less time setting up and running simulations, and more time making molds. MMT

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