Advancements in Simulation Improve CNC Machine Efficiency

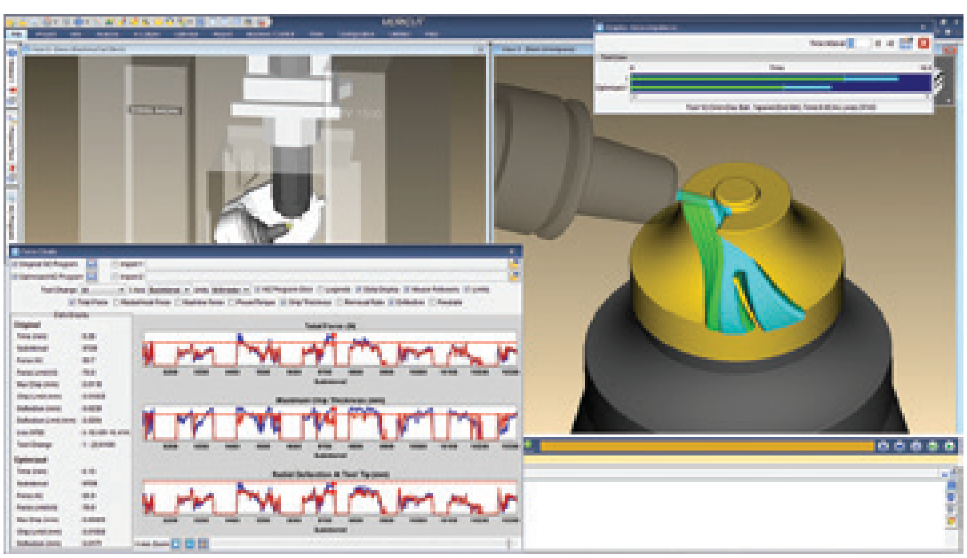
Gain Competitiveness Through High Efficiency Machining and Additive Manufacturing

To stay competitive in the global marketplace, aerospace manufacturing companies must create parts as quickly and efficiently as possible, and at the lowest conceivable cost. For machined parts, achieving the shortest cutting time is often related to feed rates, but that is only one of many factors. High-efficiency machining – choosing the optimal machining methods, while maximizing cutting tool and machine tool performance – are the real goals for modern day manufacturing. Additive Manufacturing (AM) is also now a viable manufacturing option, but many companies find it difficult to determine when it's a good fit.

Aerospace parts typically have very tight tolerances, so preventing small errors/gouges are important in the manufacturing processes. NC programs in this industry can be very long. Therefore, offline verification is key for high productivity by keeping expensive CNC machines running and making production parts, instead of wasting time proving out new or modified NC programs. Also, with more manufacturing methods available to create parts (machining, AM, hybridized methods, etc.), simulation software provides valuable information to help shops predict manufacturing times and maintain optimal production rates.

Aerospace shops are constantly being squeezed by increasingly compressed time schedules and reduced product costs (a double whammy), so they are looking for ways that can help them work leaner and faster. Focusing on the machining process, cutting tool suppliers have noted that maximizing chip thickness is the most important parameter for achieving a productive and reliable milling process. Effective cutting can only take place when maximum chip thickness is maintained at a value correctly matched to the cutter in use. A thin chip is the most common cause of poor performance resulting in low productivity. This can negatively affect tool life and chip formation. However, a chip thickness that is too high will overload the cutting edge, which can often lead to tool breakage. The degree to which this important advice is followed can dramatically impact how well machining is performed, influencing cutting tool life, and even impacting the resulting quality of machined parts.

Physics-based NC program optimization software is now available that micro-analyzes cutting conditions and optimizes program feed rates to achieve ideal chip thicknesses as much as possible, but without exceeding the tool's force limits, or the machine's available spindle



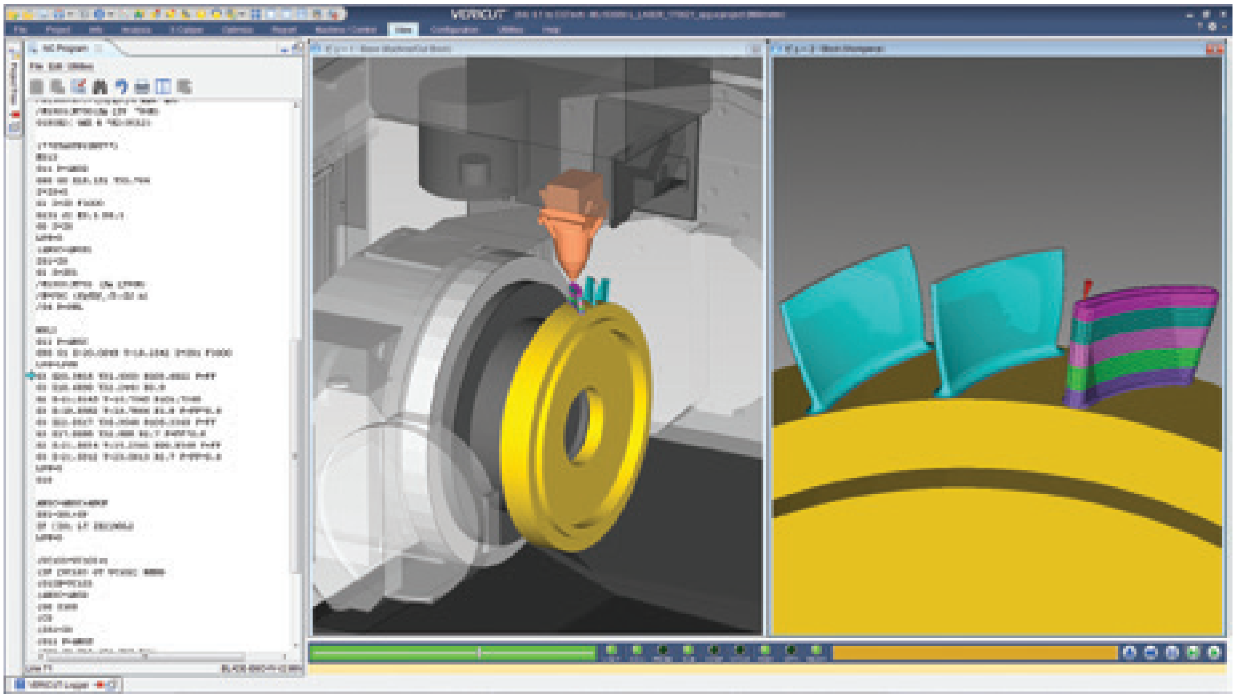
Physics-based NC program optimization software creates the most effective NC program possible by maintaining a content chip thickness while cutting.

power. This optimization technique creates the most effective NC program possible for any given cutting tool, in a particular stock material, and the machining conditions encountered. The result is significant time savings, higher quality parts with better surface finishes, and improved cutting tool and machine life. Charts in the software provide NC programmers with unprecedented viewing of the cutting process and related data. Excessive or potentially dangerous conditions appear as peaks or "spikes" in the chart graphs. Underutilized cutting tools ("areas of opportunity"), spindle power and torque requirements, and tool deflection can all be quickly identified and analyzed. This proactive analysis and optimization of NC programs makes them as efficient as possible the first time they are sent to the shop floor to be run on the CNC machine.

Another area of interest has been Additive Manufacturing. It's now possible to simulate both additive material deposition, and traditional machining capabilities of new hybrid CNC machines, all in one simulation session. A material deposition head on hybrid machines can make building certain precision parts easier and faster. And with additive programming software becoming more capable, there is a new trend: the desire to simulate any manufacturing process (additive, milling, turning, welding, etc.) in any order, to obtain the confidence to know it will ultimately add up to make the final part that was intended.

In addition to the usual NC programming problems – such as gouges, crashes with fixtures/clamps or machine components – additive programmers also must contend with AM-related parameters not being correct, such as laser activity, power, material feed, flow rate, and shielding gas activity. On top of all of that, additive hybrid machines are typically very expensive so shops using these machines do everything possible to protect their investment.

The need for more comprehensive simulation is further reinforced by most additive processes, requiring further machining (often referred to as post-process machining)



Software can simulate both additive material deposition and traditional machining capabilities of new hybrid CNC machines, all in one simulation session.

to achieve desired tolerances and surface finishes on at least some part features. This pushes simulation needs to a new level where additive process and post-process machining operations need to be simulated end-to-end, thus verifying the entire process. Simulation software also makes it possible to test various alternate manufacturing methods to help determine which will produce the best part while maximizing use of available CNC equipment.

Technology available today makes it possible to produce aerospace parts faster than ever before imaginable. But to do the best job for every scenario, companies will want to ensure their verification, simulation, and optimization software is all driven by the same NC code that will drive the actual CNC machine, thereby ensuring the highest level of profitability possible.

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