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Choosing a CAD/CAM system as model for HSC machining of modern material

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A good CAD/CAM system will help you improve quality, efficiency and competitiveness of your company. CAD/CAM system should allow you to program jobs more quickly, and handle more complex jobs. Choosing a system, especially your first one, is not a simple process. In this paper we are going to provide you with tips and insights that many companies did not learn until after they have bought the wrong system. Various subjects are examined, like CAD and CAM functionality, suitable NC-code output and guidelines for hardware selection. At the end, the effective use of the CAD/CAM system is considered.

1. BASICS

Today's PC-based CAD/CAM software grows more sophisticated. The prospective CAD/CAM users are presented with dozens of options through trade shows. It becomes difficult for a shop to decide exactly what they need. Due to a rapid development of information technologies, CAD/CAM packages can perform NC programming tasks that would have been impossible a few years ago without an expensive workstation-based system. In general, mould shops should not purchase a system for their far future plans, because at that time the software will already have been out-of-date. The current system should let them fulfill the capabilities they need now and also offer additional functions that they can add as their needs change. The authors of this article gathered many years of experience in introducing CAD/CAM systems to the production. They visited many companies which confronted the problem of the implementation of CAD/CAM system to the production. In this paper, we shall try to introduce our experiences from these visits and show you what problems the companies were confronted with.

2. SOFTWARE SELECTION GUIDELINES

2.1 CAD Functionality

Nowadays the company that is placing an order often sends already designed geometry of the part electronically to the mouldshop without any concern about how the part will be processed and manufactured. Usually, the geometry is not originally designed on a compatible system; so good translators are essential to read the designs properly. In general, the shop should be able to read geometry through translators like STEP, IGES, Parasolid, SAT (ACIS Solids), DWG,

CADL, VDA, STL and ASCII. Although the producers of CAD systems ensure a smooth translation of the geometry data, this is no always the case in every day's practice. Experiences show that a mould shop should possess tools to analyze and correct the imported geometry.

In the last few years we have observed a spread of solid modeling allowing the user to build a model from well-defined solid bodies. While solid modeling offers many advantages, there are still many applications that require surfacing. Many industries still extensively use surfaces to define a more complex geometry. Far from being replaced by solids, surface modeling capability is useful in importing, repairing and machining the organic or ergonomic forms common in tool making. Using surfaces should be regarded as a complement to solid modeling. The newer versions of the systems are capable of integration of surfaces and solids into one model, which is called hybrid modeling.

2.2 CAM Functionality

At milling operations CAM functionality should be regarded separately due to the nature of the operations. In general, milling is divided in 2D, 3D and multiaxis operations.

Even though the use of 3D operations is rapidly growing, 2D mill operations are still present in nearly 75% of all the milling work. The main emphasis should be put especially to the manner in which the cutter compensations are solved and how the programmer can involve canned drill cycles to the NC-program. The CAM system should also be able to use tombstone operations with a rotary table (Figure 1), which offers milling from different sides.

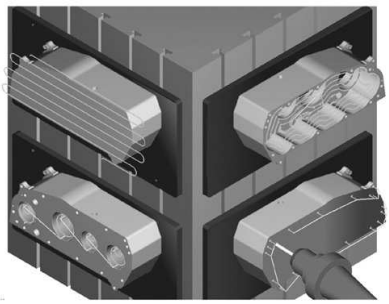

Figure 1. Tombstone operation

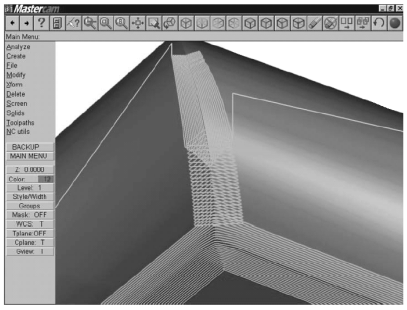

Figure 2. Restmill toolpath

A few years ago, 3D milling was limited only to pocket roughing and parallel finishing, but modern software offers advanced methods of 3D machining using special milling approaches and strategies.

Restmill toolpaths (Figure 2) are designed to automatically identify the leftovers from the previous operations and machine areas that need to be cut with a smaller tool. Milling algorithms can also change the cut method as the slope of the model changes and finally make a pencil tracing to walk a tool along the intersection of surfaces to clean out hard-to-reach areas. When machining complex parts using of multiple tool planes is necessary due to tool limitations and reduction of machining time.

Additional modules like dynamic feed rate synchronizat and high speed machining can shorten the NC program and reduce machining time. Dynamic feed rate synchronizat module (Figure 3) enables the feed decrease when the tool cuts more material, and increase as the tool cuts less material. This helps keep a constant chip load on the cutter for longer tool life and more efficient cutting. Similar to federate synchronizat is smart cornering (Figure 4), which adjusts the feed rate around corners and small radii for smooth transition in tight areas, based on the part and machine tool characteristics.

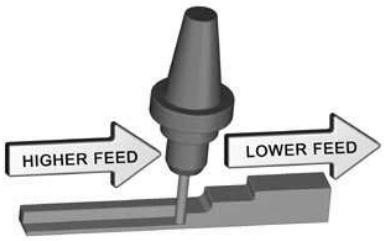

Figure 3. Feed rate synchronizat

Figure 4. Smart cornering

High Speed Machining (HSM) is a powerful machining method that combines high feed rates with high spindle speeds, specific tools and specific tool motion. HSM can deliver faster turnaround and a superior finish. CAM system should include a suite of HSM functions designed to help you make the most of this powerful technique such as: smooth tool motion on and off the part, contour paths with smooth, consistent ramping motion, smooth circle milling, using 3D loops onto and off of Z-level cuts, specialized high-speed pocketing with "trochoidal" milling.

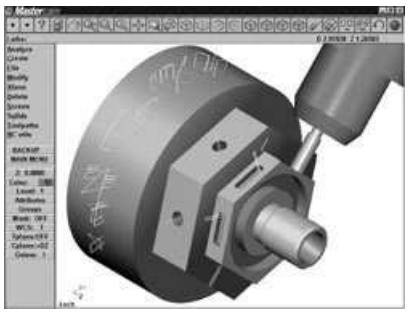

Figure 5. C-axis lathe operation using solid model

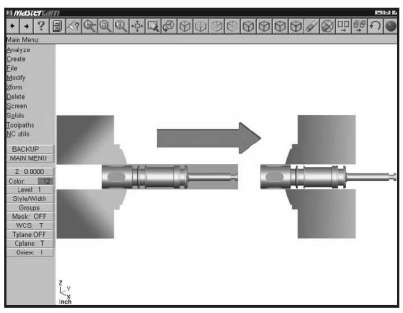

Figure 6. Multi- spindle Lathe job translation

In lathe operations customer should pay attention especially in C-axis machining (Figure 5) and multi-spindle lathes (Figure 6), which are nowadays more and more common in the shops. At Wire EDM user should devote his attention especially to 4-axis synchronization with automatic skim and reverse cuts and to efficient tab creation.

2.3 NC Code Output

Many CAD/CAM systems neglect the importance of the correct NC code output which directly influences the efficiency of CAD/CAM process. In most CAM packages, the connection link between CAM system and NC code for the machine is a post processor. The important quality of the postprocessor is its adaptability so that the NC code form is accurate to the last detail.

In contrast to 3D machining, where NC programs usually contain only simple 3-axis linear motions, the post processors for 2D machining programs are more complex. They have to offer solutions to cutter compensation and canned drill cycles, which are specific to various machine specific control types.

Many companies in order to reduce costs condense their programming division in one place, which means that the interaction between the NC programmer and the operator is minimized. Accordingly, NC programs are desired to include all the necessary additional information such as tool lists and comments to the program.

Today's NC machines are becoming more and more sophisticated and the NC output must get along to this progress. Especially the lathe and wire posts are becoming very complex, because these types of operations do not include only basic toolpaths, but they also include the translations of the job and multiple tool planes use.

2.4 Software Maintenance

We met many users who bought the system from a no-name software company that after a few years no longer exists and now they own an out-of-date package, which can no longer be updated. CAM systems should be ordered from market leader software companies with a long tradition and references all over the world (MasterCAM, …).

The next important issue is the maintenance price. Some software companies charge a substantial amount for each update (20-30%). And even more, if a customer does not regularly purchase an update, he is charged for all the missing updates. So the prospective user should also concern the price of annual updates when evaluating the software.

Also important is that there is a growth path to more powerful software because a company may not need a full 3D, 5-axis NC programming at the beginning. Higher levels of software should be available for later needs. Even if you only do milling, you should see if the company has other machining software, such as lathe or wire EDM. If you expand your machining capabilities in the future, you can get a familiar system.

Training must be efficient, so that the user can expect the first results within a few days. Shops should choose a company that provides full and immediate support, because the usage of CAD/CAM system is complex and there is often no time or money to learn from mistakes.

3. CONCLUSION

When a company is selecting the CAD/CAM system, it is difficult to consider all various aspects given in this article. But wrong decisions can cause large expenses in the future. Because of the competition on the market, it is nowadays possible to get evaluation versions of many products, which can help the prospective buyer to totally review a product before buying it. A shop should always buy products by present needs and plan the software to grow with the company.

Modern machine tools (HSM) with strong software and programs are working on a concept of constant cutting forces regarding to constant machining volume rate. In this case the dynamic effect is lower and the cutting process much more stable. To consider all summarized effect of modern machining, the results are: reduced wear on cutting edge, possibility to machine hard materials, better workpiece-surface roughness, greater accuracy and economics productivity.

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