

This year's MACH show could justifiably boast the attendance of a diverse cross-section of the world's most influential software developers – all under one roof. It was therefore the ideal venue for those, like myself, wishing to catch up on the industry developments, and the future of computer integrated manufacturing generally. *By Martin Oakham*

Software – the magic key

SOFTWARE developments at MACH08 showed a clear progression towards Computer Integrated Manufacturing (CIM) where the increasing emergence of manufacturing tools such as automatic feature recognition, advanced multi axis verification and global data management are signalling a shift in the route to increased productivity. Now that developments in high speed machining, 5-axis kinematics, one-hit machining solutions and automated machining cells are plateauing out, CNC programming is becoming the new bottleneck, tying up resources and holding up workflow. Already most of the details of 5-axis movement are out of the hands of the CAM programmer. The software determines which axes need to be moved, and when they need to be moved, and keeps an eye on collision potential and makes the necessary moves to avoid mishap. The CAM programmer is concerned only with the most suitable strategy on offer to give the best overall finish/time ratio.

Delcam's FeatureCAM range of knowledge-based CAM software products has been certified by the Autodesk Inventor Certified Application Program for Autodesk Inventor 2008.

AI/Feature Recognition

The vast majority of CAM developers exhibiting at MACH08 are moving away from operations-based interfaces, where the user is required to go through multiple steps to machine each part, in favour of process-based systems and feature recognition. Process based systems attempt to reduce the arduous task of selecting

the operation to use, the machining boundary, the toolpath strategy, tools and feeds and speeds etc. by grouping operations in standard processes that can be called up in the form of a knowledge database (expert system).

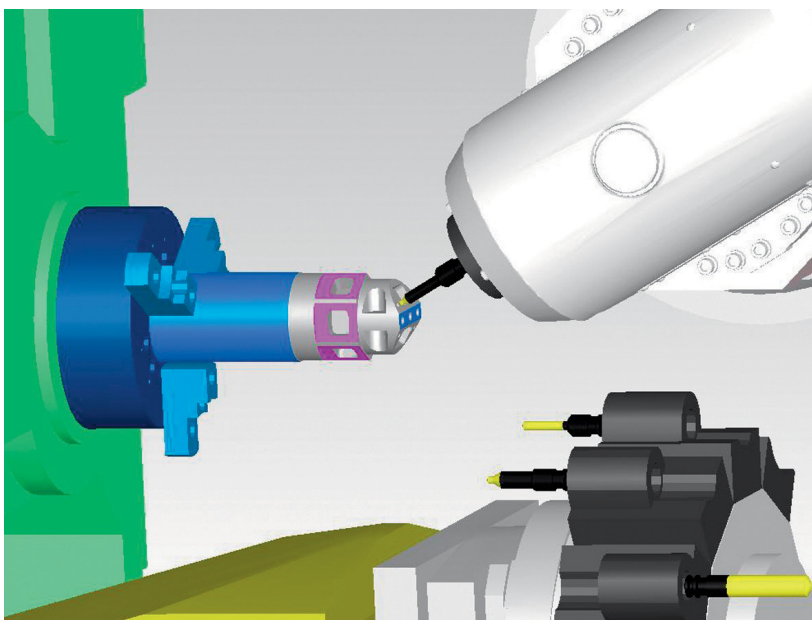
In short, the program remembers the processes used for many operations such as drilling a sequence of holes, and repeats them for future operations. However, this method only really pays dividends when the machine shop is using the same processes again and again for the same type of components. When a process is applied to different types of components, or parts made of different materials, the CNC programmer must still verify that the correct operations were used and that the correct tools, stepovers, speeds and feeds were selected. This is the reason why more and more CAM developers are now developing Feature-based CAM systems, which automatically adapt to every part based on the 'intelligence' incorporated within the CAD model.

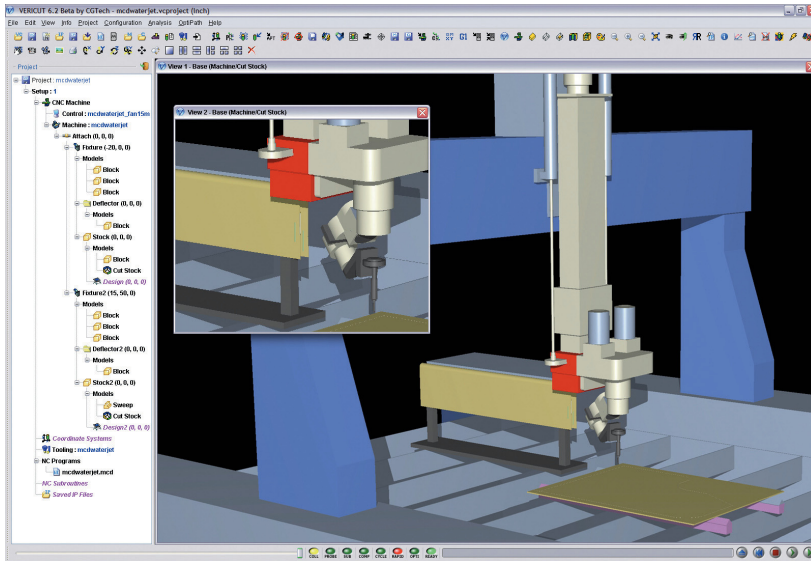
Such systems identify features that can be machined based on the CAD geometry; for example, two opposite flats with radiused ends would suggest the possibility of a slot feature. This would then be further interrogated to support or reject the findings. Each identified shape has a preferred set of associative machining rules associated with it. These 'rules' outline preferences such as how and where material removal should occur, cutting depths, whether to use conventional cutting techniques or climb techniques, whether to use a spot drill or to use a centre drill, and the preferred machining strategies for roughing and finishing, based on expert systems databases within the CAM system.

Armed with this information, the CAM system is able to evaluate the component geometry and material, select the most appropriate tools and operations, and recommend machining strategies, feeds and speeds and ultimately to generate useable NC code which can be post-processed for 3 to 5-axis continuous machine tools. In order to maximise cutting efficiency on 5-axis machine tools, strategies are emerging that use predominately continuous 3 or 4 axis motion, but which switch to continuous 5-axis motion if and only if a feature can be machined more efficiently by using additional rotary axes.

Integration

Because feature-based CAM systems must retain the design intelligence inherent in a CAD model, the direct communication between CAD and CAM vendors has





Potential crash detection via verification software applied to waterjet cutting

now become extremely important. This is why so many of the software developers exhibiting at MACH08 were making a point of advertising their partnerships with CAM developers, and vice versa. A working partnership enables seamless integration between products so that, for example, a part designed in a CAD system can be opened directly in a CAM application without the need for translation software - thus dispensing with the age old problems associated with standard translator formats such as IGES which strip the data down to its bear geometry.

Feature recognition also plays a key role in efforts to create a digital product model that can be used directly as part program input, bypassing the CAM programming process altogether. Many believe that the future lies in a 'Supermodel' which will be a 'product model' including all the information a CNC control system will need to generate 5-axis motion. Such a setup will not need an NC program as such, the product model itself will function as a universal part program, serving as machine input for any machine capable of producing the part. In such a case, the entire world becomes your factory, with the Internet acting as a global DNC network. Bearing this in mind, the battle for supremacy between the CNC developers and CAM developers is as evident as ever, though little is talked about this openly as yet. Few would argue that the process of manufacturing a component will not eventually become fully automated based on the intelligence locked up in the design.

The CNC developers are aware of this and to a large extent are already capable of generating toolpaths

without the need for traditional NC-code. The majority of digital CNC systems offer built in shop floor programming solutions that are as sophisticated as shopfloor CAM systems at programming basic prismatic components, these systems are also controlling all the motion of the machine tool and monitoring the accuracy of axis positioning, coefficients of expansion, acceleration/deceleration curves and everything else a CNC controller is designed to do.

Both CNC and CAM developers are using mathematical algorithms to calculate the shape of cutter paths based on maintaining a constant cutter load whilst maintaining the optimal cutting angle for efficient material removal. This is accomplished by analysing the amount of material in contact with the tool at any given moment and adjusting the toolpath and tool angle on the fly. Once again, this level of control is out of the reach of CNC and CAM programmers so we are already heading towards the CIM goal of push button CAM.

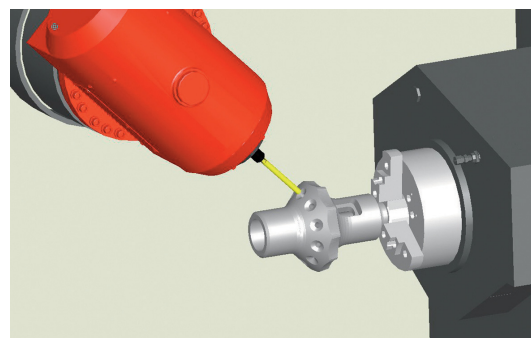
Verification

Of course with all these axes flying around under the control of computers, verification has become a must-have item. Addressing this, every CAM developer either has its own in-house developed verification module, uses a 3rd party product, or has a partnership with an independent verification specialist such as CGTech. Many have two of these options. Now that multi-axis motion is the norm in machine tool development, verification has finally come of age - companies that previously felt that they could do without this 'luxury' now see that they cannot effectively do without it. Verification greatly improves visualisation and simplifies the process of 'prove out' prior to post processing the program for the intended machine. In most cases libraries of machines are supplied as part of the latest software release or as a service pack, or can be downloaded from the software vendors website. Failing that, virtual machines can be easily developed in most commercially available CAD systems, and then transferred into the CAM system for animation.

The Future

The manufacturing software industry continues to mature, learning from developments in the wider computing industry as a whole. MACH08 showed further evidence of consolidation, with companies able to offer worldwide distribution and support bringing in specialist developers who have excelled in niche markets. This is the sharp end of manufacturing now, and will more than likely remain that way for the foreseeable future.

FeatureCAM applied to milling detailed work on a Mori Seiki millturn centre



Far right: Planit is introducing a new module to Edgcam that allows automation of the part set-up process by working in conjunction with Renishaw probing systems.

