While CAM technology has predominantly been used by the engineering community as a cost effective tool for greater efficiency in production, there is now a trend towards utilizing CAM in other creative ways. In a bold and unusual step, Victoria University of Wellington, New Zealand, made one such creative use, when it decided to adopt CAMWorks as part of its curriculum for third year Industrial Design students.

Now firmly established as part of the core course, CAMWorks enables the University's students to investigate direct control of milling textures and patterns as an integral part of their designs. Tim Miller, Senior Lecturer at Victoria University points out "As we are not a traditional engineering school, it's the design aspect that we are actually interested in. Right from the outset, the idea of the project was to take students down a route of understanding the basics of virtual object creation through a CAD platform and then, more importantly, consider the physical creation of the object through the CAMWorks software." In doing so, the school has taken CAMWorks use down a road less travelled' with some very interesting results.

It was back in 2002 that Victoria University decided to use Geometric's CAMWorks to provide a holistic approach to its industrial design students – thereby, enabling them to understand not just the CAD modeling of an object but also the CAM angle. The University was already using SolidWorks®, the industry-leading 3D CAD software. Hence, the choice of CAMWorks, which offers plug and play integration with SolidWorks, was almost automatic. The single window integration within the SolidWorks environment means that CAMWorks uses the same SolidWorks geometry to generate tool paths, which ensures that the part being machined is exactly the same as the modeled part. This modernizes the design innovation by significantly accelerating design revisions, and eliminating training for students on multiple software platforms.

The idea behind the University's CAM project was to expose the students to the machining process, exploding myths that machining was an engineering sphere. Using CAMWorks made it a lot easier for the students to understand the entire machining process.

Training on the CAM platform was integrated into the curriculum through short projects spread over two weeks. Miller says, "The principal behind the whole project is that CAMWorks makes it a lot easier for the students to understand the process of machining. Given the ease of use of the software, it also allows non-engineering experts to access parts of the manufacturing process that was formerly only accessed by engineers."

The Project

At Victoria University, students are encouraged to explore different patterning processes on virtual surfaces by using CAMWorks to machine the surface through techniques such as contour machining, zig-zag, and flowline machining. All of these have a different visual effect on the surface that is being machined, and students have been known to create nearly 25 virtual models, varying the surface form by changing the machining details.
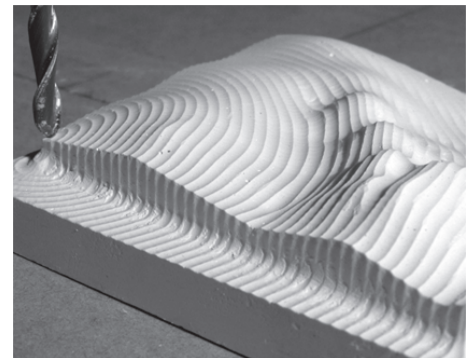

Figure 1: Cuts from a spiral pattern machining show the relationship between pitch and topography.
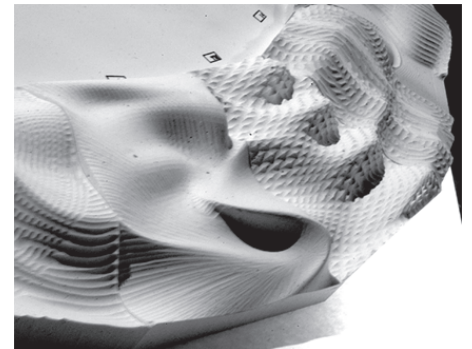

Figure 2: Multiple overlaid machined textures enhance the surface form.

CAMWorks®

n HCL Technologies Product

CAMWorks

CAMWorks is the first fully integrated computer-aided manufacturing (CAM) software designed exclusively to operate in SolidWorks and the first to offer knowledge-based, feature recognition and associative machining capabilities within SolidWorks. CAMWorks uses the same SolidWorks geometry to generate toolpaths to ensure the part you machine is the same part you've modeled.

CAMWorks helps manufacturers across aerospace, automotive, electronics and medical industries optimize and evolve their CAM automation process. CAMWorks modules are available in a variety of combinations and bundles: 2½ Axis Milling 3 Axis Milling 4 and 5 Axis Prepositioning 4 and 5 Axis Simultaneous Milling 2 and 4 Axis Turning Rotary Milling 2 and 4 Axis Wire EDM

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The students are, then required to machine their models on actual 100mm X 100mm plaster blocks with a depth of 20mm, cutting the block in the smoothest way without any post processing. In doing so, the students can better comprehend and have hands-on knowledge on how surface textures can be created on a physical surface by the machining process.

The focus of the project is to experiment with the textural quality of the surface. As Miller says "It's got nothing to do with machining efficiency or speed of machining, it's all to do with visual quality of the end surface." In a sense, he points out, it is what a sculptor would do with a mallet and chisel on a piece of wood – the sculptor creates the effect by removing pieces of wood, but the end effect is also determined by the manner and technique with which the wood is removed.

Visualizing with CAMWorks

"What's wonderful about CAMWorks is the fact that you can virtually see all the machining parts before you actually machine them on the piece of material," says Miller. Students could, therefore, see what

Figure 3: Students radial edge profiles matched together to produce a continuous circular form.

pattern would occur and plan towards the achievements of certain effects on the material.

Another unusual experiment conducted by Miller and his students was the machining of one pattern across another pattern, resulting in interesting and unique end effects. Elaborating on this, Miller explains how one can start out with a wide pitched zig-zag machining, and then change the angle of the next machining for instance to 45 degrees - the end result is the appearance of a remarkable diamond shaped patterns on the actual surface!

The Student Experience

For the students, CAMWorks enables acute visualization of the end results, a key element for designers, while also allowing them to get a sense of the vast possibilities of machining. As Miller says "It prepares the students (for the future), and it gives them a bit more insight into what can happen in industry. The point of using CAMWorks is not just to show the students how virtual modeling is done – this is done quite easily in many three dimensional programs. What is more difficult to explain is the relationship between a virtual object and an object made from CAM data. And I think that CAMWorks is excellent for doing this and illustrating, what the benefits could be from using software such as CAMWorks. "

For the University, the CAMWorks project is important as it builds-up its reputation for being at forefront of digital technology and innovation. "We believe in exploring digital technology, it is our forte, and this is one vehicle to show that process" says Miller.

"I'd like to thank Geometric for lending us the software and allowing us to do this project. What we're doing here is just the tip of the iceberg. There's a lot more one could actually do with Geometric and CAMWorks. I think further research in this area will give us the chance to really see what the opportunities might be."

License for Growth

A core reason behind the successful run of CAMWorks at Victoria University has been the backing of Geometric (provided by Geometric reseller NC Computer Systems, Australia). Geometric lent the University the software for the project. "Because the project is only for two weeks, we couldn't have paid for the software for the whole year. So, Geometric has been extremely supportive by lending us the software during the period of the project". Last year the University actually bought four copies of CAMWorks, but continues to enjoy flexible licensing from Geometric as the software is being used by 40 students doing the course.

What makes the Victoria University implementation stand out is the unusual end use the software has been put to by the customer. By providing the university with a special licensing policy that allows use of licences over multiple PCs, Geometric has triggered an unusual trajectory for CAMWorks, one that may pave new roads to explore the full potential of CAM software in the future.

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