



Ultra High-Performance Toolpaths Now Available to Any Shop

By Alesa Lightbourne, Ph.D.

“Kernel” technology has brought important enhancements to the CAM industry, removing many of the factors that once distinguished competitors. No kernel, however, addressed the limitations in cutting tool movements that underlie all toolpath technology. A new solution changes this. Previously available only on the most popular systems, it is now offered in a CAM-neutral version—translating into efficiency improvements up to and exceeding 100 percent in virtually any CAM environment.

Have you ever wondered why ancient Greek columns are striated with long vertical indentations? Historians tell us it’s because the earliest Greek temples were made of wood. When builders switched to stone, they carefully scored columns to preserve the appearance of logs.

A similar process occurred in machining toolpath technology. Before the advent of computerization, machining was done the good old-fashioned way—manually, with crank handles to drive tools through materials to shape parts. But when computer programs allowed machines to move by themselves, CAM software developers essentially replicated the cutting motion that operators had used for decades. These involved parallel-offset routines, with numerous sharp directional changes for roughing out parts.

A Better Course of Action

Computer-controlled machines are capable of much more sophisticated motion than those manually operated by humans. By working from the perspective of CNC machine capability, rather than the most expedient way to make machines move on their own, engineers have developed a new toolpath model. Called an ultra high-performance toolpath (UHPT), it replaces multiple jerky motions and a parallel offset with a single continuous, smooth action. Eliminating all the stops and starts of previous

solutions, it more than doubles machine output, enhances safety, and improves tool life.

UHPT technology is so new that it is not yet widely adopted or even understood. This is due in large part to the diversity of CAM vendors’ offerings and the lack of universality; therefore, integration could be slow in coming. Now, however, UHPT developers have overcome the final hurdle to widespread implementation—they created a UHPT product that will work at the end-user level with any CAM system.

UHPT technology, a best-of-breed solution in computer numerical controlled machining that can double efficiencies, is now offered as a stand-alone product, usable on any CAM platform.

How We Got Here

Why is this so remarkable? Consider the history of the CAM industry. In the 1970s and 80s, dozens of CAM vendors emerged, each writing their own code to display graphics, manage data, and generate toolpaths, along with scores of other tasks. This internal development was expensive, but represented the only way a manufacturer could get a product to market.

Naturally, the various systems tended to focus on the areas of general expertise of their founders or lead product designers. Some excelled at generating toolpaths for machining complex, free-form surfaces, such as those required for machining molds for organically shaped consumer products. Others were superior in the production milling and drilling of the prismatic shapes common to component parts. Since each product had its pros and cons, developers were constantly trying to improve on weaknesses to pull even with, or gain or maintain an advantage over, their competitors. Although essential for differentiation in such a crowded market, enhancing areas of relative weakness required expert computer talent, and diverted much-needed resources from vendors' core capabilities. It was a question of investing heavily in software development or dying—a lose/lose scenario.

Then in the mid-90s, MachineWorks (Sheffield, UK) began marketing software for simulating the material removal process. Designed specifically to be incorporated into any CAM system, and targeted at CAM software developers rather than end users, MachineWorks' "kernel" or "toolkit" was priced to undercut the cost of internal development. The concept was so successful that today very few CAM vendors write their own code for simulating material removal, a capability that users have come to expect from any full-featured CAM system. Instead, vendors simply license a solution from one of the firms that focuses on this technology.

The result is that a CAM system capability that was once a possible differentiator between systems has become virtually ubiquitous. This is good for end users, who can be less distracted by ancillary functions when choosing a CAM system. It's also good for the CAM software companies, who can better concentrate their product design and development resources on the hub of their technology rather than on the spokes. And, obviously, it is good for the companies that provide the kernels.

Expanding the Use of Kernels

Kernels have since found their way deeper into CAM systems, and have been effective in further leveling the playing field. For example, many CAM systems were inherently weak in the area of multi-axis milling. Internally developing code for complex 4- and 5-axis milling applications is resource intensive—and, with few exceptions, has produced only marginally effective capabilities. Then ModuleWorks (Aachen, Germany) appeared on the scene, providing a toolkit of powerful multi-axis milling algorithms that could be incorporated into any CAM system. By paying a license fee and expending a relatively small amount of development effort, companies with weak multi-axis capabilities became strong almost instantly. With perhaps as many as half of the viable CAM software companies adopting this toolkit today, multi-axis milling has become almost a non-issue in competitive positioning.

More recently, the trend to license third-party software has expanded down into 3-axis milling toolpaths. In the past, companies with stronger 3-axis core competencies dominated this large market segment. But the emergence of kernel technology for 3-axis milling applications has changed this. CAM companies with

relative weaknesses in this area can now remedy their problems quickly and cost effectively. Because fewer CAM companies have shortcomings in 3-axis applications than in 5-axis, and since the availability of strong 3-axis kernels is more recent, this technology has not been as widely adopted, though it is an emerging trend.

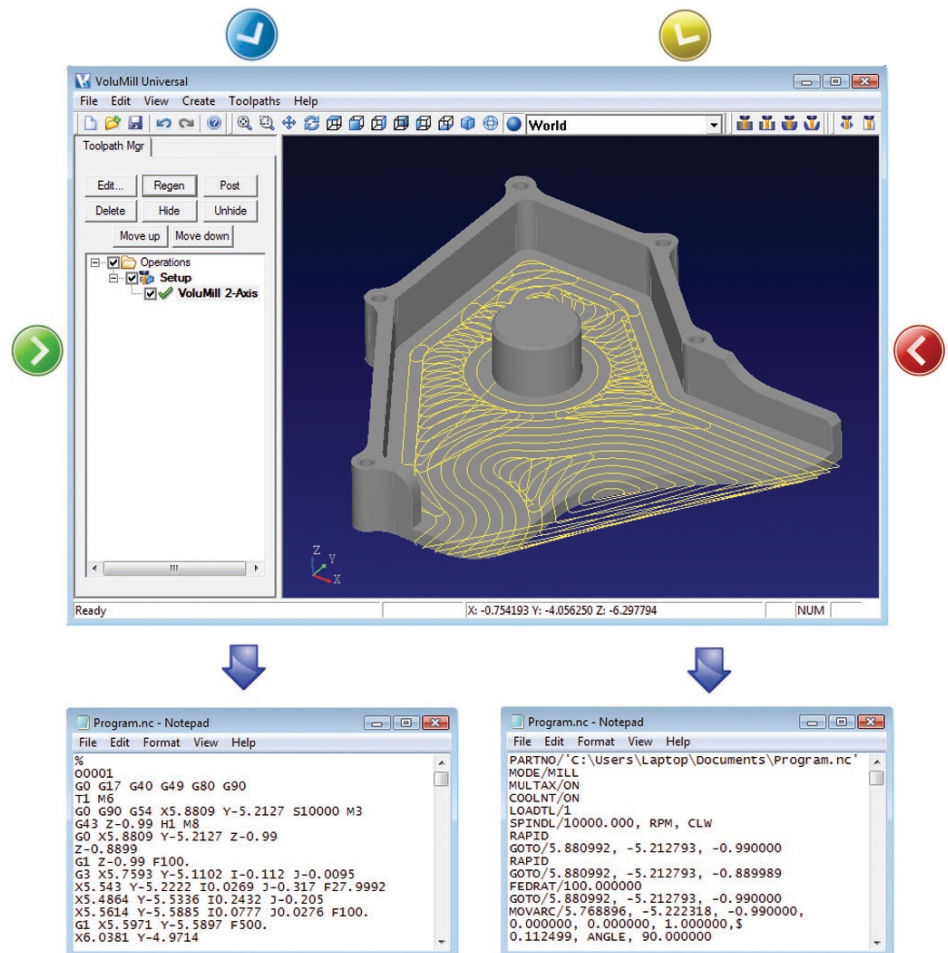
Despite the availability of kernels for specific disciplines, three important factors have been overlooked.

1. Though the kernel-based toolpaths may compute more quickly, be more accurate, and work more effectively on a wider variety of parts, they typically do little to increase the productivity of the milling process on the shop floor.
2. Kernel-based toolpaths do not focus on the most common tool motion required for bulk material removal, namely 2-axis milling.
3. Kernel-based toolpaths can't help an end user if his CAM vendor doesn't license and implement them.

End-User Availability— An Industry First

Celeritive Technologies has introduced a revolutionary toolpath technology that addresses all three of these shortcomings. Called VoluMill™, this UHPT drives machine tools and cutting tools along paths that leverage the hardware's full capability, dramatically reducing machining times while extending the useful life of machine tools and

cutting tools. Customers have reported rough-milling productivity increases of up to 400 percent, with cutting tool life extended by a similar factor. And since VoluMill toolpaths are designed to mesh perfectly with a machine tool's inherent capabilities, less horsepower and torque are required and the stress on drive components is significantly reduced, even when more aggressive machining parameters are used.



VoluMill Universal™ is designed to take part designs from virtually any CAD/CAM system and create VoluMill toolpaths. These toolpaths can either be post-processed into your machine's G-code or exported back into your CAD/CAM system.

VoluMill toolpaths easily and accurately handle any 2- or 3-axis rough-milling task. This kernel is the first to focus specifically on the overlooked but vitally important 2-axis milling market. With rare exceptions, the vast majority of the material removed to produce a part or mold is rough milled with 2-axis tool motion. Improving the efficiency of such material removal is resulting in tremendous productivity increases.

To make the situation even more interesting, add in platform neutrality—a true industry first. A new version of UHPT technology, VoluMill Universal™, can be used by any end user, regardless of their CAM system.

Operating as a stand-alone toolpath engine, VoluMill Universal reads geometric data in the popular neutral file formats, generates high-efficiency

VoluMill toolpaths, and outputs machine control data for any machine tool. Like most kernels, VoluMill is available as a direct plug-in to some CAM systems and is integrated as an OEM technology into others. Now with the introduction of VoluMill Universal, any shop, anywhere, using any CAM system, can increase productivity and reduce costs immediately.

Given that these toolpaths have been proven to significantly reduce cycle times, extend tool and machine life, and result in dramatic improvements in milling efficiencies, we can expect widespread deployment over the next few years. We can also predict that other manufacturers will follow Celeritive Technologies' leadership in developing new products that go beyond creating a better mousetrap, to fundamentally changing the way that we think about catching mice.

Celeritive Technologies, Inc. was founded to develop and market advanced productivity-improving CAD/CAM technologies. VoluMill™ offers a new genre in high-performance toolpath engines that significantly increases machining productivity and product quality. This innovative, powerful toolpath engine is easy to use, performs on any part geometry, and can be used with any CAM system.

For more information and to take advantage of the 15-day free trial offer, visit the VoluMill™ Web site at www.volumill.com

