

FORCE

CGTECH
VERICUT

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VERICUT® FORCE



WHY FORCE?

// You have good NC programs, but would like them to go faster //

// You want to prevent tool breakage and increase tool life //

WHAT IS FORCE?

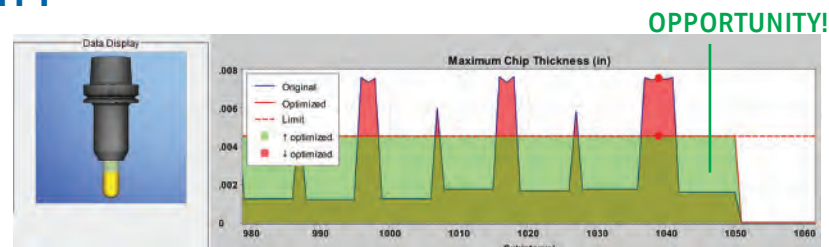
Force is a physics based VERICUT module for feedrate optimisation, based on the workpiece material characteristics and the related cutting tool parameters. Consideration is given to number of teeth, helix and rake angle as well as the general geometric shape of the tool. The software also considers cutting material type: carbide or high speed steel - when does the tool break? Does it have a straight or serrated edge? How does the chip form?

1 QUICK RESULTS

- Force does NOT require any user knowledge - it works on the basis of known values!
- No expensive software tests are required.
- No reprogramming required.
- Force works well even when removing high volumes of material.

2 INCREASED PRODUCTIVITY

- Shorter production times mean cost savings.
- Improved part quality.
- Reduced tool wear.
- Machined parts - Fast the First Time with VERICUT Force.
- Increased competitiveness as parts can be produced even faster.
- Smoother machining through reduced peak loads with less wear on the CNC machine's drives and spindle resulting in longer tool and machine life.



3 PRACTICAL Optimisation

- Force charts make it easy to find unproductive regions in the NC program. This gives the user two options:
 - Use Force to optimise individual feedrates on the basis of cutting force, chip thickness or spindle power.
 - Re-program in your CAM system.

WHAT CAN FORCE DO?

Force determines the optimal safe feedrate for a specific cutting condition on the basis of 4 factors: load on the cutting edge, spindle power, maximum chip thickness, maximum permissible feedrate. This technology was developed by United Technology Corporation (UTC) and CGTech has further developed, tested and commercialised as VERICUT Force.

Force calculates ideal feedrates by analysing tool geometry and parameters, workpiece material characteristics and cutting tool material, detailed cutting edge geometry, and VERICUT Smart Part Technology.

Force calculates cutting conditions using specific material characteristics, taking into account the strength of the material, shearing condition and the effects of friction and temperature.

The material characteristics are based on physical cutting trials performed under laboratory conditions, not just on the basis of hypothetical calculations.

The unique material characteristics used by Force

provide the most accurate cutting force calculations possible today. Force is perfectly suited for metals which are difficult to machine with complex multi-axis operations like 5-axis flank milling.

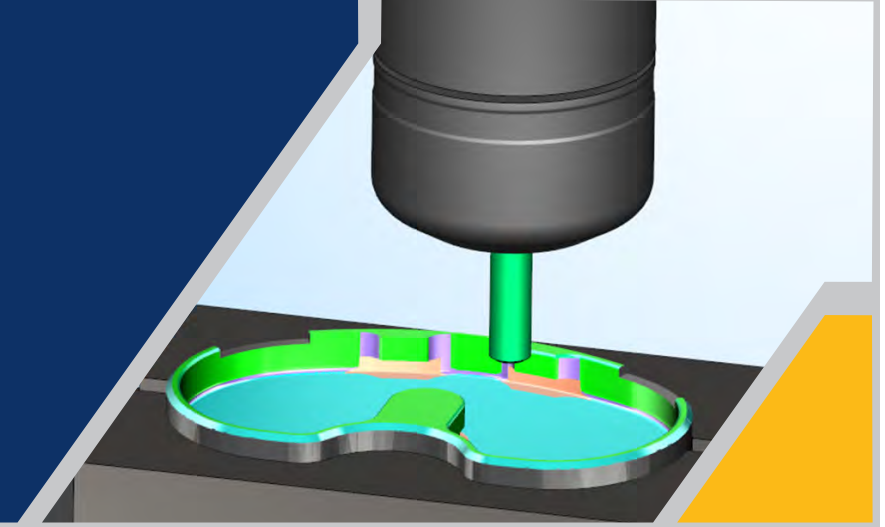
Once the workpiece material has been properly characterised it can be applied to a wide range of cutting tools and CNC machines for future machining operations. Cutting tool bending can be predicted and tool deflection controlled.

Differences to other optimisation methods: Toolpath trajectories are not altered, but the individual spans are considered and ideal feedrates applied. Optionally, long moves may be split into smaller segments, each with its own ideal feedrate. Depth and width of cut are not changed.

ADDITIONAL FORCE CAPABILITIES...

- **Force Milling:** optimise milling processes for faster cycle times, maximised chip thickness and improved cutting tool performance.
- **Force Turning:** optimise lathe turning and mill-turn operations, when combined with Force Milling, for more efficient cutting conditions.
- **Force Materials:** choose from our comprehensive catalogue of material characterisation files to ensure ideal optimisation matched to your workpiece.
- **Force Material Catalogue:** subscribe to our catalogue and access all available material characterisation files.
- **Force Calibration:** calibrate materials for use with Force Optimisation (Milling or Turning) via a material characterisation file.
- **Force Analysis:** graphically analyse cutting conditions generated by an NC program against selected target values to reveal areas of opportunity and areas of concern.
- **Tool Performance Database (TPD):** ensures all tools have cutting performance data.
- **Machining Optimisation Data (MOD):** displays cutting data in a table to suggest start values for optimisation.





David Magnall
Innovation Partnership Manager, SECO Tools

A collaborative partnership between cutting tool technologies specialist, SECO Tools, and the world's leading independent CNC simulation and optimisation software provider, CGTech, is harnessing exceptional results for even the most demanding of customers.

For a number of years, SECO Tools has been hosting its Inspiration Through Innovation (ITI) event at its impressive Innovation Hub in Alcester. Up until the global pandemic it had been a physical 'open house' event highlighting the cutting tool specialist's range of products and engineering application knowledge.

David Magnall, Innovation Partnership Manager, recalls: "The ITI event started out as a traditional open house and we would invite other businesses, that we called partners, to exhibit at the event so visitors could glean as much information as possible from their attendance. At the time there was no true collaboration. However, we started to recognise that customers wanted more. As engineering departments have been whittled down and down, large businesses expect their suppliers to provide technical support."

"As a tooling supplier we can usually make an incremental change, but if we interact with other companies that are part of that manufacturing process, we can deliver improvements as a collective which is more of a holistic solution. For our event we started to engage partners to focus on actual

customers issues and components. It allowed us to demonstrate what we and our partners believe to be best practice manufacturing solutions. From there the idea grew and we thought we do this once a year why can't we do this every day?"

CGTech, in partnership with SECO Tools, can provide turnkey solutions for businesses looking for high efficiency gains. As David Magnall points out: "Customers are looking to take at least

"At a typical cost per hour for the industry you are looking at around £700,000 per year saved as well."

David Magnall, Innovation Partnership Manager, SECO Tools

40% and up to 60% or more out of the manufacturing process, in terms of cycle times and therefore cost, and we need partners to achieve this. These are partnerships where we sit down at the beginning of the year and say what we want to achieve together, what can we do that is pro-active rather than wait for projects to come in and highlight what we recognise in the market that needs to be addressed. If we know 'what is keeping you awake at night', then we can take that

pain away."

SECO Tools has used VERICUT CNC verification and optimisation software for many years with an established track record for getting results. "We have always used VERICUT, not just in the UK, but globally. At our production sites, anything we are programming could not run without being proven in VERICUT first. The use of the software is pretty much a standard operating practice, so we have worked closely with CGTech for a long time. For me, and many people in the company, VERICUT is the industry standard for CNC verification software," David Magnall states.

Today's collaborative approach builds on the history between the two businesses so they have created a method of providing more holistic process improvements for customers' manufacturing operations. This was bolstered even further when the Force module within VERICUT, which uses a physics-based optimisation method to determine the maximum reliable feed rate for a given cutting condition based on four factors: force on the cutter, spindle power, maximum chip thickness, and

maximum allowable feed rate, was introduced to the SECO engineering team. David Magnall says: "It looked good on paper, as these things often do. Being engineers we thought we are going to have to give this a try. Some tests were set up and the CGTech staff were confident that what we saw on paper would be replicated, physically on the machine. "So, we set up some material trials, and we were gobsmacked - we did not expect

the positive results we achieved and the more difficult the application or material, the greater savings we were seeing. And, it also addressed that paradox that you get from customers wanting a faster cycle time but not at the detriment of the tooling. No one wants the tooling to wear out quicker or the process to become less stable because you are running faster.

"However, the way the Force software works by evening out the peaks and troughs of the load on the cutting tool, it gives us a much more stable cutting process that is kinder to the tool and the machine. It raises the bar on productivity because it balances out the load on the tooling so there is no detrimental effect to pushing it harder. That was the real eye-opener for us - in some cases we were getting better tool life, and a more constant load on the spindle achieving smoother machining cycles."

With the capabilities of VERICUT Force now proven to the engineering team at SECO, the partners thoughts turned to the real value of applying it to actual customer components. A forged 6Al-4V titanium aerospace component highlights the results as David Magnall explains: "We had already reduced the cycle time of the complex pylon bracket down to 4 hours, but just running it through Force reduced it down to 3 hours, which is just phenomenal. It's not like we are just turning up the feedrate hoping that the process holds together, all the clever stuff is done in the Force software. By balancing out the load we are not seeing any decline in tool life, but we see an improvement on cycle time."

These Force applied savings translate into other industry sectors. As well as aerospace, the SECO Innovation Hub in the UK also specialises in the medical sector. David Magnall points to a tibial tray, part of an implant used for Total Knee Arthroplasty, as an example of how

Force can be used. The part is attached to the shinbone and supports the upper part of the implant. Typically, tibial trays are made from titanium, which exhibits higher tensile strength than the surrounding tibia bone.

"Now, if you just look at the numbers on the tibial tray," he says, "you are only looking at a 15% saving. This equates to around 40 to 50 seconds, which may not sound a lot but if you look at one manufacturer that is often making between 600,000 and 700,000 tibial trays per year, that represents a significant cost saving. Cycle time is critical to medical manufacturers, if they can shave 40 seconds off the process it could save a substantial amount of capital investment because of the capacity that the time saving buys back. Just on cost savings alone at a typical cost per hour for the industry you are looking at around £700,000 per year saved as well."

Continuing, he adds: "Environmental sustainability is a huge topic within the manufacturing industry, and although people have talked about it for a long time there is now pressure to start making good and deliver. There are targets being set that people are working towards. Also, it's not just the products, it is the whole manufacturing operation that needs to be more sustainable and more environmentally aware. We are certainly seeing it more and more with customers, they increasingly want to only do business with other companies that have some sort of sustainability plan in place. Using VERICUT Force results in savings that are

many-fold. The cycle time reductions and tooling life increases are knowns.

However, from a business improvement and sustainability point of view we should also consider the reduced power consumption from any machine tools running for less time and drawing less spindle power to cut the raw material. And increased shopfloor efficiency may negate the need to invest in further machine tools; making better use of what is available."

Summing up the collaborative partnership, David Magnall says: "We have a great team at SECO, and our business model is always to try to provide a one stop shop. But we only have a finite resource and by partnering it helps us achieve the customers' goals. The Force software does some really clever stuff and the support that we get from the CGTech team is second to none. If you are going to pick a company to work with as a partner these guys are it, they really are. They understand the collaborative approach as a pro-active way of working and addressing the issues faced by industry."



"Force makes a night and day difference. On my very first try, it cut the cycle time by 35% on three separate machining operations. It also increased tool life by 150-200%. It was pretty amazing."

B. Eaton, Steelville Manufacturing

"To be honest, I used Force on a program that I'd already optimised with a popular CAM system, so I really wasn't expecting much improvement. But Force lopped 40% off the cycle time on the first go. It was pretty impressive to watch."

J. Giraldo, Sandvik Coromant

"VERICUT's Force module saved at least 17% on even the most basic part geometries. On those considered more complex, reductions of up to 45% were typical."

G. Bare, iMFLUX

"Not only does VERICUT help us to assure that the first part is a good part, but it also reduces our setup times, eliminates broke tools, and prevents crashes."

J. O'Toole, Keselowski Advanced Manufacturing

"Tool breakages must be avoided, especially in demanding machining operations. The same applies to thin-walled parts, where avoiding deformation of the part due to excessive cutting forces is key."

T. Fink, Starrag Group

"The savings achieved so far are around 22% reduction in machine cycle times with programs optimised by Force, with a substantial improvement in tool life as well."

M. Hoffmann, Premium AEROTEC



UK - CGTech Ltd.

Curtis House, 34 Third Avenue
Hove, East Sussex BN3 2PD
TEL +44 (0)1273 773538
info.uk@cgtech.com
www.cgtech.co.uk

CGTech® is the leader in CNC machine simulation, verification, and optimisation software technology. Since 1988, our products have been the standard in manufacturing industry sectors including; aerospace, automotive and ground transportation, mold and die, consumer products, power generation, and heavy industry. With subsidiary offices throughout Europe and Asia, and a global network of resellers, CGTech software is used by companies of all sizes, universities, trade schools, and government agencies.

CGTech maintains an active Technology Partnership program. VERICUT users in this program include many of the world's leading machine builders, CAD/CAM developers, and manufacturing software companies.



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reputation in the business!