VERICUT® FORCE

Right First Time. Fast First Time.

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 optimization, 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. What is decisive is the 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! Also 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 First Time with VERICUT Force.
- Increased competitiveness as parts can be produced even faster.
- Smoother machining through reduced peak loads are kinder to the CNC machine's drives and spindle result in longer life of the machine too.
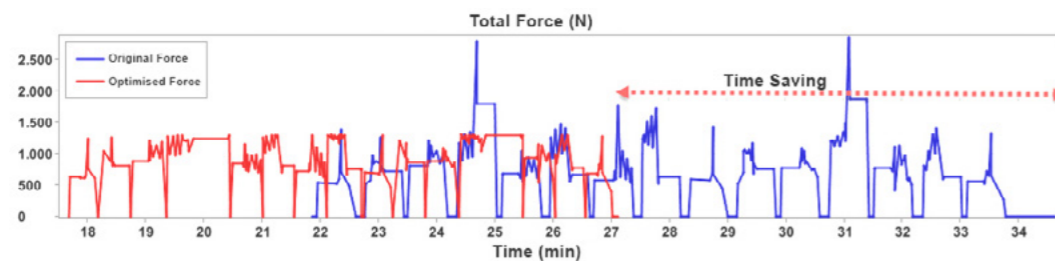
3 Practical Optimization

- Force charts make it easy to find unproductive regions in the NC program. This gives the user two options:
  – Use Force to optimize individual feedrates on the basis 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 has been developed by United Technology Corporation (UTC) for over 7 years. CGTech has further developed, tested and commercialised as VERICUT Force.

Force calculates ideal feedrates by analysis of: 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 characterized 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 optimization 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.

WE ALSO NOW HAVE...

- Force-Milling: Optimize milling processes for faster cycle times, maximized chip thickness and improved cutting tool performance.
- Force-Turning: Optimize 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 characterization files to ensure ideal optimization matched to your workpiece.
- Force Material Catalogue: Subscribe to our catalogue of material characterization and access all of available material characterization files.
- Force-Calibration: Calibrate materials for use with Force Optimization (Milling or Turning) via a material characterization file.
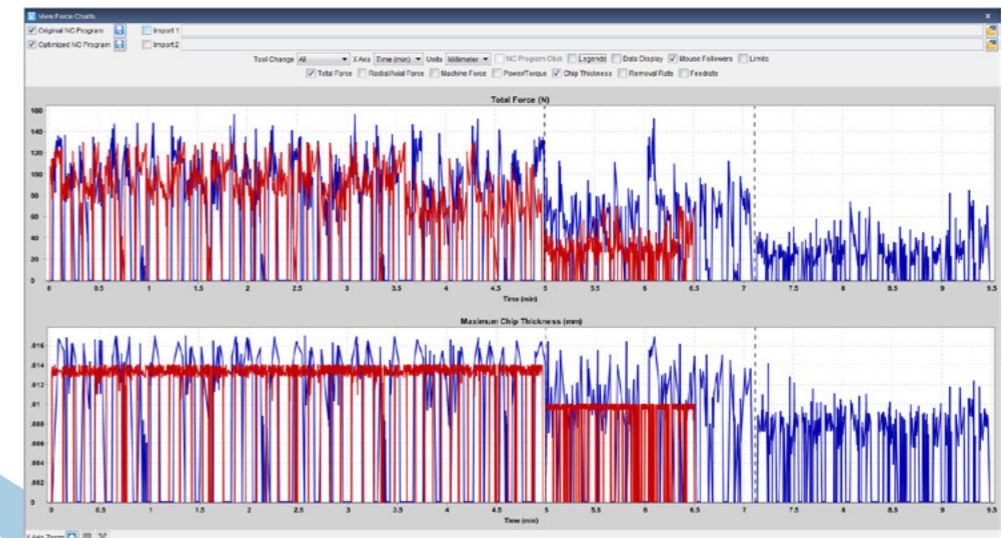
Force in Practice

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**Economic precision processing in the aerospace industry
with NC Simulation (VERICUT®) and maximum operational reliability
feed (Force)**

Aerospace experts are anticipating a significant growth, with more than 30,000 new passenger and freight aircraft required by 2033. This is going to pose immense quantitative and qualitative challenges to the existing aerospace manufacturing plants. Augsburg-based Airbus subsidiary, Premium AEROTEC, is ensuring its participation in this fiercely competitive field with the support of CGTech's NC simulation software, VERICUT, and the application of the new Force module for ongoing operational reliability and machining efficiency.

Premium AEROTEC

Premium AEROTEC is one of the world leaders in the development and manufacture of structures and manufacturing systems for civil and military aircraft alike. With locations in Augsburg, Bremen, Hamburg, Nordenham, Varel and Brasov (Romania)

Europe's leading aviation suppliers develop and manufacture the very latest in modern aircraft structures, from aluminium, titanium, and carbon fibre composites for the entire Airbus family.

The company is a key partner in the development and production of the A350 XWB, as well providing parts for the

» **Force is the most innovative productivity tool available** «

Tony Shrewsbury, Managing Director, CGTech Ltd.

Boeing 787 'Dreamliner', the Eurofighter Typhoon, and the Airbus A400M heavy lift military transport aircraft. Premium AEROTEC was established in January 2009, with the merger of the EADS plant in Augsburg with the facilities of Airbus Germany in Nordenham and Varel. Under the governance of the Airbus Group, the

company's headquarters are in Augsburg. Here, around 4,000 people are employed with the focus on the manufacture and assembly of fuselage parts and heavy duty structural components for military and civil programmes, with the use of hybrid lightweight structures, carbon fibre technologies, infusion processes, and sandwich construction techniques.

NC simulation prevents machine collisions

To guarantee the surface quality and workpiece tolerances required, high performance material machining techniques are employed in Premium AEROTEC's production area. These techniques must meet the defined quality required without scrap or elaborate repeat machining to rework components. They must also minimise the wear on the machines and cutting tools, reduce downtimes to a minimum, and be highly efficient even with complex components running in small batches; in other words,

they must be fast, precise, reliable, and reproducible: without compromise.

Of course, this is an environment familiar to many in the aerospace sector, where machine tool safety and security are critical to meet ongoing delivery targets. To ensure this the company has used the industry standard NC simulation software, VERICUT, as an integral element of its manufacturing processes since 1991. The fundamental aim is to avoid machine tool collisions, either with the structural components of the machine, the raw material or component, and even the fixturing systems.

VERICUT® and AUTO-DIFF™

VERICUT was chosen to check the NC code that generates the milling paths on the machine tools, and in 26 years of use it has more than proved its worth. "Today, there are no more prove-outs required on the machine. No NC program goes onto the machine without having been tested first in VERICUT" explains Werner Flagner and Michael Hoffmann, under whose supervision more than 30 Premium AEROTEC personnel work with VERICUT.

The leading independent NC simulation and optimization software, CGTech's VERICUT simulates the entire CNC manufacturing process, regardless of

the machine, control system, and CAM systems involved, and tests the NC program for interference and errors before anything runs on the real machines. More than 25 different machining centres used at Premium AEROTEC are simulated using VERICUT.

AUTO-DIFF is a very important VERICUT module at the Augsburg plant. It provides an automated identification of the differences between a CAD model and a workpiece simulated by VERICUT. With this module, anyone involved in the manufacturing process can detect points that have been incorrectly processed, or errors in the programming. "It is an ideal tool, that is particularly important when extremely expensive parts are involved, and which, when it comes to allowances and tolerances, has proved to be indispensable," says Werner Flagner. "AUTO-DIFF helps cut programming time and speeds up the entire process," adds Michael Hoffmann.

Maximum operational safe feedrates
Given the high material removal rates, of up to 98%, is it even possible to achieve a reduction in production times - including setup, part handling, measuring, and run through? There are several approaches to improving machining efficiency. These include machining in a single

VERICUT® and Force

• Premium AEROTEC uses CGTech's new product Force to maximize operational reliability in difficult-to-machine materials and complex multi-axis operations.

• Force optimizes customer specific workpiece parameters and associated tool settings.

• With VERICUT® NC simulation Premium AEROTEC avoids collisions and costly rework.

• AUTO-DIFF™ enables you to compare a CAD design model to a VERICUT simulation to automatically detect differences. Anyone involved in the production process can identify incorrectly machined areas.

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setting, with the integration of different manufacturing procedures. Ideally, the complete machining process takes place in 'one-hit' reducing positioning errors or damage to the components during manual handling. Optimized workholding strategies and new machine tools with modern cutting tools also have the potential to increase cutting speeds, material removal volumes, and improve machining qualities, while also increasing service life. However, process safety and security remains an absolute requirement in manufacturing, and that is why Premium AEROTEC has applied the new physics-based module, Force, from CGTech to increase efficiency while maintaining operational reliability.

Image Source: Premium AEROTEC

Unique on the market: Force

Force is the culmination of a joint development between CGTech and UTC (United Technologies Corporation). A physical and scientific optimization method, Force is a software module within VERICUT that uses known physical parameters to determine the maximum reliable feedrate for a given cutting condition based on four factors: force on the cutter, spindle power, maximum chip thickness, and maximum allowable feedrate. It calculates ideal feedrates by analysing tool geometry and parameters, material properties of the stock and cutting tool, detailed cutting tool edge geometry, and VERICUT cut by-cut contact conditions.

Managing Director, Tony Shrewsbury, explains: "It relates to helix and rake angle, as well as the general geometric form of the tool. What is decisive is the material type - whether carbide or high speed steel - and the load at which the tool breaks. As loading peaks are also displayed in Force, these can be managed and reduced to, smooth the loading to make the cutting action less shocking to both the tool, workpiece and the elements of the machine tool."

Another advantage is that Force does not need any user findings; it is optimized solely based on the values determined. Likewise, no elaborate software tests are required. He goes on: "The issue is not about milling strategies of existing programs. No toolpath needs to be changed. Force simply divides, or splits, the path to introduce improvements. Everything is governed by the feedrates, so the toolpath trajectory is not altered."

22 percent savings from the start

Premium AEROTEC has really gained right from the start with the new Force solution. The savings achieved so far are around 22% reduction in machine cycle times with programs optimized by Force, with a substantial improvement in tool life as well. Tony Shrewsbury is confident there are still more potential benefits to be seen in the future: "Force is extremely well-suited to materials that are difficult to machine, and for complex multi-axis operations. We are encountering both these factors increasingly, not only in the aerospace sector but in all precision machining industries. For real world efficiency gains, Force is the most innovative software currently available."

22% — Faster machining cycle times have been recorded by Premium AEROTEC since the use of Force to optimize NC programs.

>25 — Different CNC machining centers are currently being simulated with VERICUT® at Premium AEROTEC.

26 — Years VERICUT® experience at the Augsburg-based aviation and aerospace specialist. More than 30 Premium AEROTEC employees are currently working with VERICUT NC simulation software.
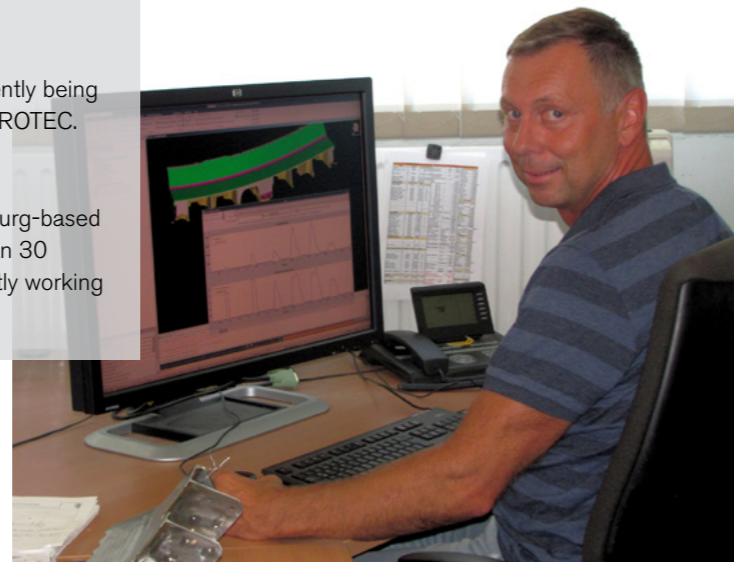
VERICUT ©

Why CGTech

VERICUT software is used to simulate CNC machining in order to detect errors, potential collisions, or areas of ineffciency. VERICUT enables NC programmers to correct errors before the program is ever loaded on the CNC machine, thereby eliminating manual prove-outs.

VERICUT also optimizes NC program cutting speeds for more efficient machining.

Why VERICUT°?

When you invest in VERICUT, you're not just buying a software program; you're teaming up with a manufacturing partner with the largest group of CNC machining experts in the world.

We are continually exposed to new manufacturing methods and technologies worldwide, gaining expertise that can give you a competitive edge.