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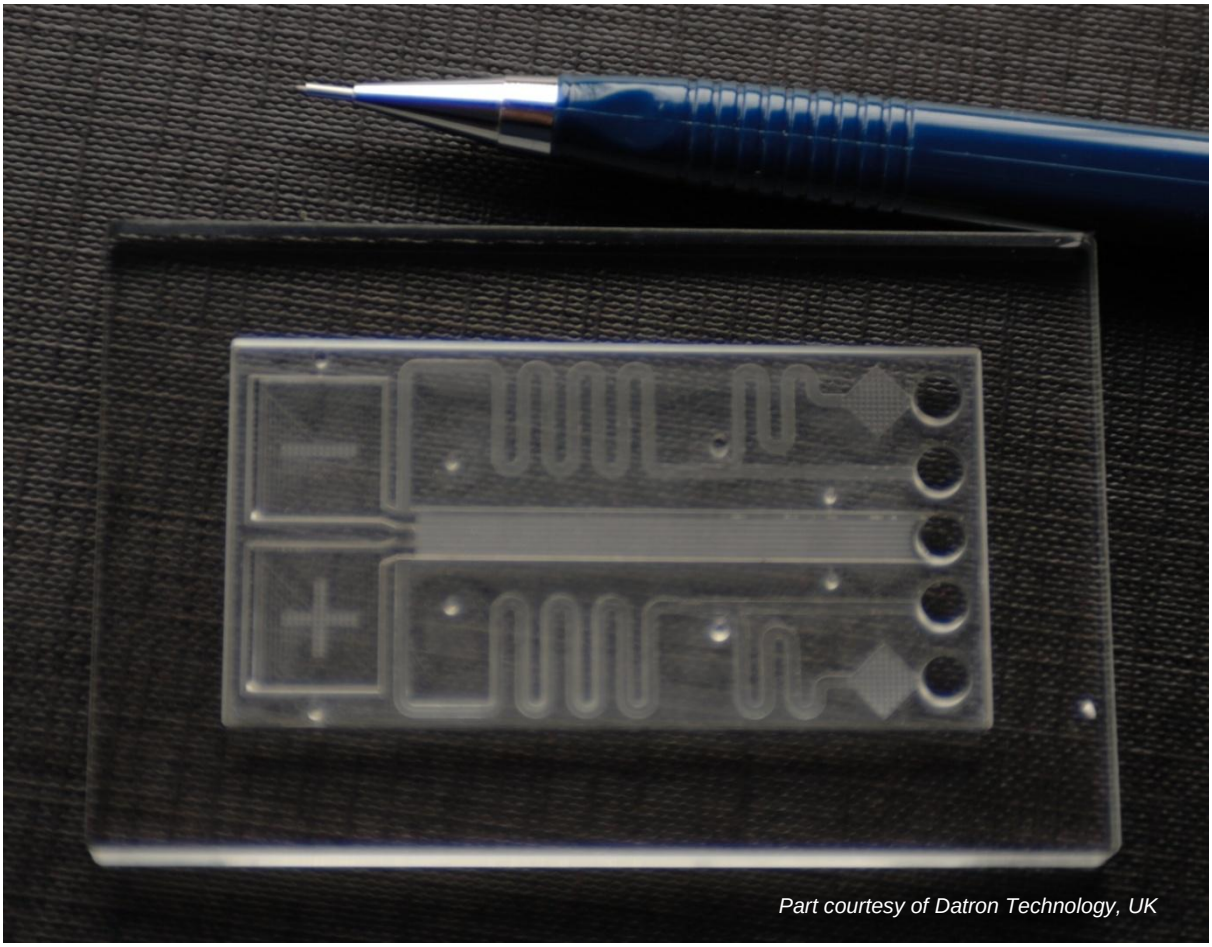

NCG CAM for Micro Machining

High Speed, Precision Accuracy

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NCG CAM for Micro Machining

Key Benefits of NCG CAM

NCG CAM is perfect for the high speed machining of moulds, dies, prototypes and precision surface machining.

-Stand alone CAM software that is compatible with ***most*** other CAD package

-Extremely easy to use with just 1 day training required to machine a live job

-Ideal for shop-floor programming

-Powerful and reliable 3D machining

-Optimised toolpaths for high speed machining

- •Increased efficiency
- •Reduced wear on machine
- •Extended tooling life

-Save time, save money !!

Target Engineering Industry Sectors

Mould & Die	Modeling & Prototyping	Medical Parts
Core / Cavity Machining	Injection Mould & Blow Moulds	Motorsport
Die Casting	Electrode Machining	Forging Die
Jewellery		

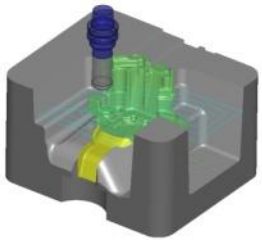
Main Features of NCG CAM

-Easy to learn and use

-Quickly computes efficient, reliable toolpaths for even the most complex geometries, with highest quality surface finishes

-Assembles all precision high-speed machining processes into a single package:

- Fast, robust and reliable 3-axis machining
- Support for 3+2 machining (5-axis positioning)
- High-speed machining strategies, optimised approach, exit and connections for roughing, rest-roughing, finishing, rest milling and more
- Tooling library with material/feed/speed/cutting conditions
- Stock models allow visualisation the part after each machining step
- Post-processors included for many machine controls. Easy to customise post-processor from a GUI



-Add-on simultaneous 5-axis module is available

-Add-on machine simulation module available for basic module. Included with add-on 5-axis module

-Supports multiple CAD systems and data formats

-Extends tool life and reduces wear on machines with its optimised toolpaths, feed-rate optimisation, and anti-vibration capabilities

What is Micro Machining?

Micro machining is simply machining parts that are very small or miniature.

Micro machining has been about for many years, but is becoming more common as everyday technology becomes smaller across industries such as aerospace, medical, automotive, information technology and telecommunications.

How is Micro Machining Different from Other Types of Machining?

In theory, micro machining is just down-sizing the part and tooling, and adjusting the feed rates, etc accordingly. However, when milling parts with 0.1mm diameter tools in non-ferrous metals, there are a different set of challenges to consider.

Things to consider carefully:

Type of CNC Machine

High speed milling machines are ideally suited as they have a high RPM, smaller step-over but increased feed-rate. Some machines are purposely built for micro machining, which are lighter and have a high-speed, low-force spindle specifically designed for micro-tooling.

Spindle Speed

High speed machining spindle speeds are required to efficiently machine small parts and avoid tool breakage, typically between 35,000 – 100,000 RPM and are specially balanced and vibration free. Approx. 60% of the heat is in the chip; by removing these chips at such high speeds keeps the tooling and part cooler. This also creates lower cutting force and therefore less vibration. All of these points result in better accuracy and surface finish.

Tooling

Micro tooling has a diameter of 1mm or less and works best with high speed spindles of 35,000 RPM or more. The tooling should to be optimised specifically for high-speed machining applications, to allow for the increased chip removal and to prevent chip build up. The tooling should also run extremely true.

Coolant

Low viscosity coolant, such as ethanol is often used.

Machine Environment

Due to the small scale of the parts produced, any small change to the temperature, etc in the room can make a difference to the size of the part.

CAM Software

Software should be suited to high speed machining, be very accurate and finish to a high quality, as many parts are too small to be polished.

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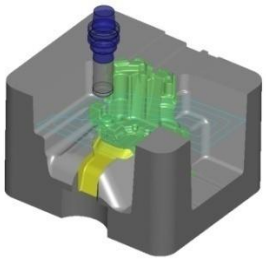
Why is NCG CAM Suited to Micro Machining?

NCG CAM was originally written purposely for high speed machining. Due to the importance of using high speed machining routines when micro machining, many of the features in **NCG CAM** are ideally suited to this area, as follows.

Area Clearance Roughing



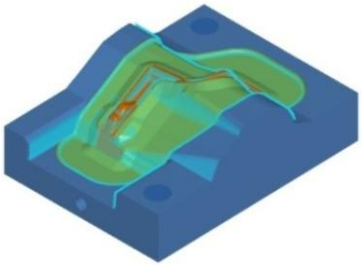
NCG CAM's automatic roughing of surface data is suitable for all types of 2D or 3D forms, creating an optimised, smooth cutting motion for high speed machining (HSM) while maintaining, part accuracy, cutting tool life and machine tool life. All cutters and tool-holders are collision protected to maximise efficiency and stock model visualisation of the machined part is available at every stage of the manufacturing process.

True Surface Machining

True surface machining is optional for users to select, should they wish. Machining the surfaces spaces the points in the NC Tape file more uniformly, giving a better / smoother machine movement on some machine tools. However, the calculations to ensure the machining is gouge free will take longer in most cases.

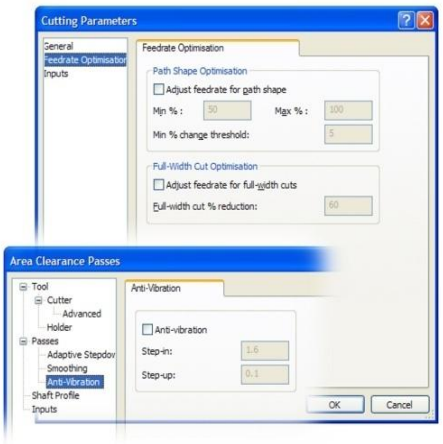
Above – *Machined part .* ***Left -*** *True surface machining.* ***Right -*** *Machining triangulations.*

Waterline (Z –Level) Machining Using Surface Contact Angles



Waterline passes can be used for semi-finish and finish machining the more vertical areas of a part. If a slope angle is specified, for example between 30° – 90°, the steeper areas are machined, leaving the shallower areas between 0° – 30° for more appropriate strategies.

Linking options for waterline passes include bi-directional and one-way machining. Bi-directional machining will maintain contact with the part by climb milling one-way, then conventional milling the other, but should only be used for non-critical machining. Climb milling is the default cutting direction, with options for conventional and bi-directional milling to maintain tool-life, accuracy and good surface finish.



Feed-Rate Optimisation

NCG CAM has feed-rate optimisation for area-clearance, core roughing, rest roughing and water-line machining. The software is aware of the cutting conditions, if the current toolpath is machining the corners where the cutter will be in full-width contact, **NCG CAM** looks ahead and adjusts the feed-rate down to maintain accuracy and prolong tool-life.

When **NCG CAM** is performing a ramping entry move for area clearance roughing, the ramping feedrate is used. Once the cutter is to depth, the cutting feed-rate can also be reduced as this first cut will be the full width of the cutter. This is then returned to the normal feed-rate once the cutter is not making a full width cut.

Why is NCG CAM Suited to Micro Machining?

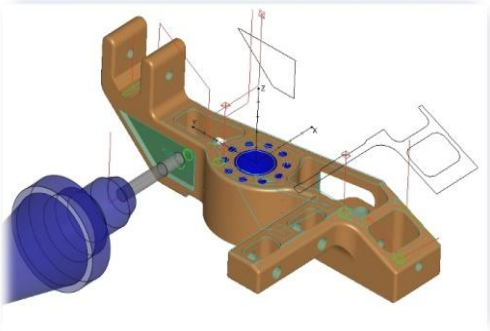
Edit Surface Trimming Holes & Boundaries

When machining components or moulds, it is sometimes necessary to remove holes and / or apatures from surfaces to enable more efficient manufacture. **NCG CAM** has functionality which will enable the user to remove individual holes, even on doubly curved surfaces, or remove all the inside trimming edges as shown right.

NCG CAM also has the ability to create internal fillets, this can in some instances allow a more flowing toolpath. Planar patches can also be create to cap or protect areas if needed.

Multi Axis Machining

For some parts such as miniature impellers, there may be a need to machine using 3+2 or full simultaneous 5-axis, to give greater flexibility and access. **NCG CAM** also has features for these instances.



3+2 Five Axis Machining

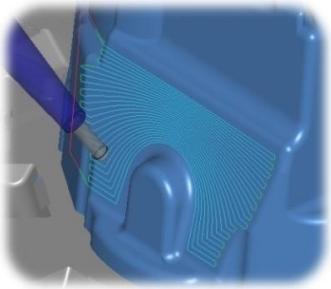
3+2 multi-axis machining has an easy to use graphical interface, including being able to snap to the surface normal for machining.

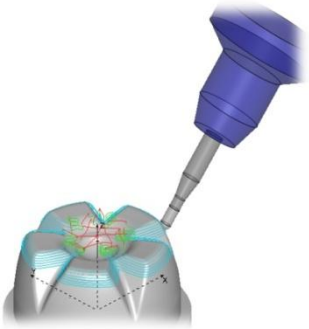
This enables the user to reach deep and complex areas by rotating the part or the head of the machine tool through a combination of A, B or C axis rotations. Once in position, all machining routines are available and are fully gouge protected for the tooling and the holder and can be used in conjunction with cutter contact angles.

Simultaneous 5-axis Add-on Module

NCG CAM simultaneous 5-axis module is an add-on to the base module of **NCG CAM**. It does not run as a standalone product.

Simultaneous 5-axis and 3+2 five axis machining allow the use of shorter, more rigid cutters for higher feed-rates and optimised machining time. All toolpaths have automatic collision prevention for both cutter and tool-holder.





Tool axis control allows the user to have some control of how the tool tilts:

- Tilt through or away from a point
- Tilt through or away from a curve
- Full gouge avoidance of cutter and holder
- Lead/lag and tilt angles available
- Minimal tilt to avoid cutter and holder collisions
- 3, 4, or 5-axis options. When selecting 4-axis, the user has to say which axis the 4th axis rotates about.

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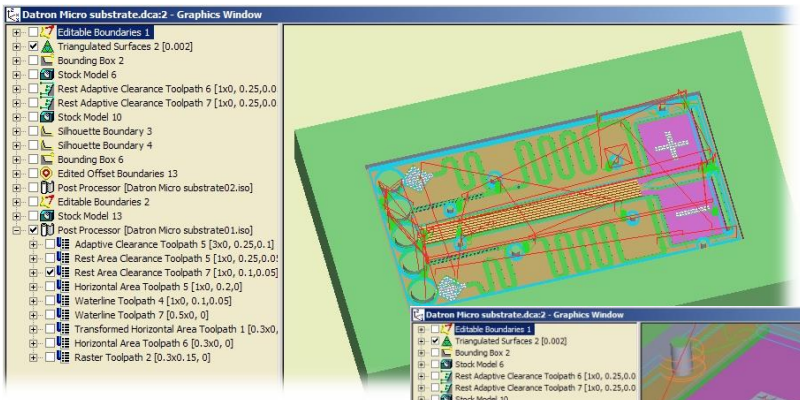
Example Micro Machining Part Machined with NCG CAM

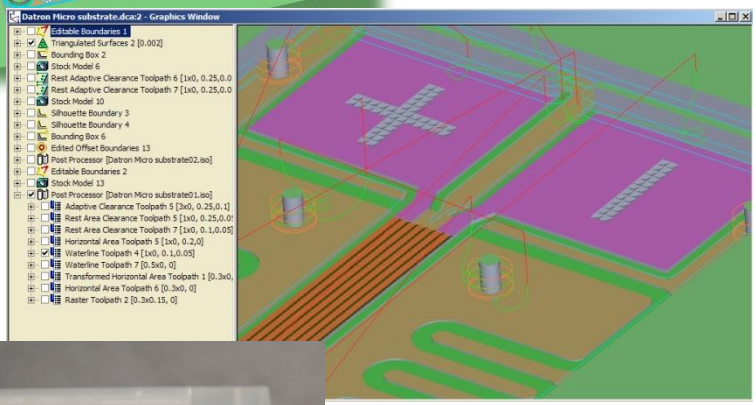
Medical Micro Machining Part Machined with NCG CAM

This sample part was machined from acrylic plastic on a Datron 7 machine tool with NCG CAM.

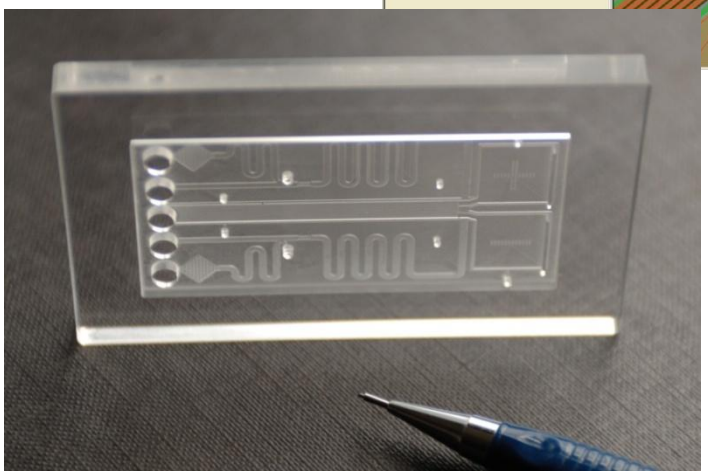
Tool	Tool Diameter & Type	RPM	Feed-Rate
T3	3.0mm Single Flute	28,000	2.2 m/min
T2	1.0mm Single Flute	30,000	1.5 m/min
T6	0.5mm Twin Flute	30,000	0.6 m/min
T7	0.3mm Twin Flute	30,000	0.6 m/min
T11	0.2mm 40Deg Engraver	30,000	1.2 m/min



Left- *General view of the part.*



Right- *Close up of the part showing the detail and waterline passes.*



Left- *Machined part.*

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