NCG CAM Solutions Ltd.

NCG CAM for High Speed Machining

High Speed, Precision Accuracy

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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

-Saves time, saves 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		

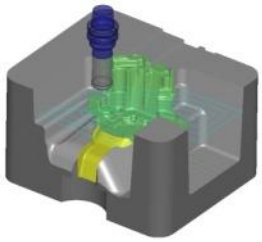
Main Features of NCG CAM

-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-processors 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 High Speed Machining?

High Speed Machining (HSM) is the ability to directly machine parts by applying high spindle speeds with which a high time-chip volume is achieved, without compromising machining accuracy or quality. This in turn minimises the need for spark erosion and hand-finishing.

HSM is suited to 3D and complex parts with small cavities as it uses a small step over; it is not suited to more simple jobs that have a large step-over as it may actually take longer to machine.

True HSM machine tools have spindle speeds of 30,000 – 100,000 RPM (typically 5 – 10 x faster than general purpose machines), but other types of machine tools can be driven to achieve higher spindle speeds in a similar way. The result of this, is an increase in manufacturing efficiency and a reduced time to market.

How is High Speed Machining Different from Other Types of Machining?

Key components of High Speed Machining (HSM):

Toolpath Generation

It is important that the CAM system used is suitable for HSM and also for machining with carbide inserted cutters. A CAM system that generates poor toolpaths can result in decreased feed-rates, reduced cutter life and poor quality of finish adding the need for polishing. In summary, it is additional costs that can be avoided.

A toolpath programmed to machine at 2000mm/min will average maybe only 60% of this on a typical part. Most CAM systems today still conventional mill in many areas, causing undue stresses and wear on carbide inserted tips or solid carbide tools and “fresh-air” cutting is still seen resulting in many more unproductive hours.

Toolpath to Machine Tool Controller

With HSM small radial moves are used to maintain feed-rates, which means there is more data and so the tape files are much longer than with standard machining methods.

The best way to get large tape files into the machine tool quickly, for the machine to process, is to use some of the computing characteristics of newer controllers, which have networking capabilities. Data can be transferred from a computer hard disk into the controller at a speed of 10Mbs or 1000X faster than transferring via a serial cable such as a RS232 at 9600 baud rate.

Machine Tool Controller

Most newer controllers (Heidenhain TNC530, Siemens 840D, Hurco Ultimax) can process large quantities of data very quickly; typically 300XYZ blocks/second (cycletime of 3 milliseconds). This type of processing speed is necessary when taking very quick light cuts, to achieve a high quality surface finish.

Some older machine tool controllers (Fagor) can split this process and have an external PC convert the CNC code to machine tool binary data for processing in the controller. This causes the machine tool to dwell, reducing the loading per tooth on each insert, causing rubbing which can work-harden some steel such as P20 and H13. Acceleration back into the steel then results in intermittent cutting throughout the job, which greatly reduces the life of carbide tools.

How is High Speed Machining Different from Other Types of Machining?

Machine Tool

High speed machining centres are expensive, because they use spindles that are low torque, but very high speed. HSM high 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.

The machine tool design is important, some machine tool builders use stationery tables to give more rigidity and this also helps the machine tool builders to calibrate the machine better as the moving mass is constant. Acceleration and deceleration can therefore be calculated and controlled better, but this can be expensive. Machines where the table moves (XY) are generally more affordable, but as the weight of the job affects the inertia of the machines motion, so calculating or compensating for the acceleration and deceleration is more general. The rigidity may not be as great as it is for a gantry machine.

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.

Cutting Tools

Originally only high speed steel (HSS) cutters, which wore too fast in tool steels were available. These have now been replaced with different types and grades of inserts and solid carbide cutters, that can do things that the HSS equivalents struggled to do with great ease.

However, these carbide cutters are less flexible than the HSS cutters; they expect to climb mill, they do not like shock loading and they need to remain under constant loading. This means that the toolpaths output by the CAM system need to be suitably written for carbide cutters and the cutter should also have the correct cutting geometry for HSM and the material.

Why is NCG CAM Suited to High Speed Machining?

NCG CAM was written purposely with HSM in mind and has many features designed to optimise cutting conditions for more rapid machining. Working closely with specialist cutting tool and machine manufacturers, **NCG CAM** optimises toolpaths for machining die steels with carbide insert and solid carbide cutting tools.

Toolpaths Designed for HSM

NCG CAM creates toolpaths as a two-stage process. The first stage is to generate the passes, which will become the toolpath.

The second stage is to insert the linking moves that describe how the tool moves from the home position to the work-piece, its cutting direction, how it links from one cut pass to another and its rapid moves and can actually rapid within the work-piece. This can save vast amounts of time, particularly when specifying one-way milling where the passes are 'open' and a rapid move is needed from the end of one pass to the start of the next. Where conventional CAM systems would retract to a Z clearance plane, **NCG CAM** keeps the cutter in the work-piece.

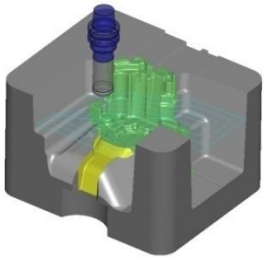
By having a small radius in the internal corners of a pass, **NCG CAM** allows there to be a greater transition between the axis, removing any dwell marks and maximises speed. **NCG CAM** has a small radius between all changes of direction, maintaining feeds and minimising shock loading on the cutter and machine; so is suitable for carbide insert cutters.

Helical ramping is used in **NCG CAM** to clear the area underneath the cutter as it descends into the job helping to prolong the cutter life.

Why is NCG CAM Suited to High Speed Machining?

Area Clearance Roughing

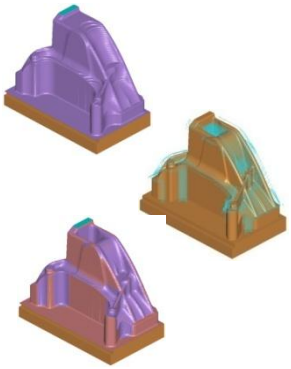
NCG CAM's automatic roughing of surface data is suitable for all types of 2D or 3D forms, creating an optimised, smooth cutting motion for HSM while maintaining, part accuracy, cutting tool life and machine tool life.



Where traditional toolpaths have sharp corners, **NCG CAM** creates arc moves. When post-processed for machine tool controllers, they are output as circular interpolation moves. The result is that a part programmed to machine at 2000mm/min will achieve this feed-rate on the whole job. The immediate benefit is an improvement in machining time of up to 50% over conventional CAM systems.

When moving from one Z-level to another, contact is maintained between the cutter and the steel. This reduces shock loading and improves tool life. Climb milling can be maintained at all times and **NCG CAM** either helix-ramps or profile-ramps down to the next Z-level. When roughing there is no possibility of making vertical plunge movements, which can quickly chip and break carbide tooling.

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.



Rest Roughing

Having roughed the part, there will often be many areas that the larger cutter was unable to machine. This can be due to the part having radii smaller than the cutter diameter, surface details that slope away and pockets which the cutter simply could not fit in to.

Rest roughing can identify the un-machined areas of the part and generate a 3D stock model. From this stock model, the software can calculate a new roughing toolpath, which machines only the un-machined parts of the job, eliminating any wasteful air cutting.

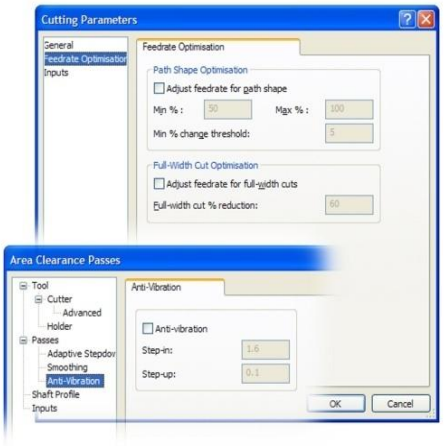
Rest roughing can also be used when machining castings. The passes can be trimmed back to another surface model; the resultant rest toolpath is fast to create and cuts out multiple tooling operations, fresh air cutting and set-up time.

Vibration Free Machining

When creating area clearance or core roughing toolpaths, **NCG CAM** has an option for anti-vibration machining. This feature greatly reduces vibration, an important feature for all machinists. This helps to maintain consistent cutting conditions, prolonging the life of the machine tool and cutting tools. In turn this produces a more accurate part at the roughing and rest roughing stages, enabling the finishing toolpaths to provide consistently more accurate parts with a good surface finish, saving both time and money. This is done by holding the cutter off the side walls when cutting the bottom and lifting the cutter up slightly when cutting the sides.

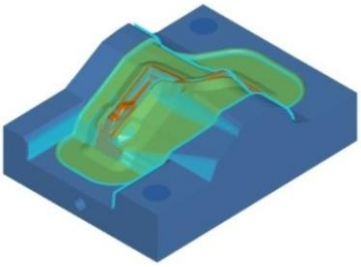
Why is NCG CAM Suited to High Speed Machining?

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 avoid overloading the cutter, 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.

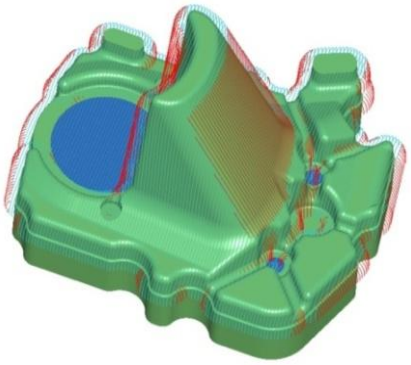


Waterline (Z –Level) Machining Using Surface Contact Angles

The concept of putting arcs in the toolpaths follows through to all other machining operations. Z-level (waterline) machining when used for semi-finishing, has smoothing arcs within the toolpath to maintain even cutting conditions. It can also be used to 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° – 40° 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-level, then conventional milling the next level down 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.

Raster Machining & Perpendicular Raster Machining



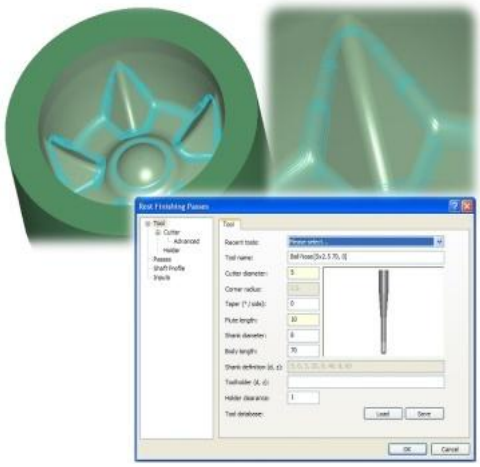
Raster toolpaths are used for finishing in conjunction with steep and shallow cutter contact angles and another machining routine, typically waterline. The raster toolpath can very quickly generate a toolpath for the shallow areas or the part, typically using cutter contact angles of around 0° – 40° and waterline 30° – 90°.

This approach uses the best machining combination for finishing complex 3D surfaces and can be used on older CNC milling machines or high speed machines alike, maintaining constant feedrates and eliminating dwelling.

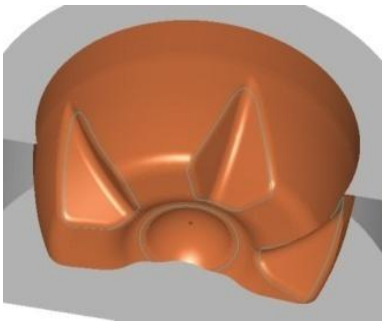
Perpendicular raster toolpaths are used for finish machining the whole component with a constant surface finish and at the same time maintain a climb milling direction. Perpendicular raster passes as it suggests, machines using raster passes in one direction. It omits passes on the steep faces that are parallel with the cutting direction and then fills in the gaps with another raster toolpath at 90° to the previous, thus maintaining surface finish.

Why is NCG CAM Suited to High Speed Machining?

Rest Finishing Machining



The rest finishing is aimed at semi-finishing and finishing internal corners. The area machined is limited by a reference cutter, defined by the user. A ball nose cutter is used, steep areas are separated from shallow areas, like all other types of passes the cutter and holder are protected from gouging. Spiral like passes allow for the milling direction to be maintained in the shallow areas. In the steep areas, the cutter is kept on the part as much as possible, reducing any air cutting.

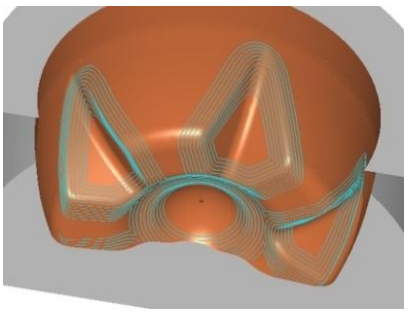


Pencil Milling

The pencil milling routine is to finish corners which might otherwise have cusp marks left from previous machining operations. This is ideal for machining into corners where the surface radius is the same as the cutter corner radius.

Single pass pencil milling gives a high surface finish ready for polishing. When machining, the toolpath maintains climb milling as default and can be used in conjunction with cutter contact angles. As with all toolpaths in **NCG CAM** they can be animated alone or with holders.

Parallel Pencil Milling



Parallel pencil milling is crucial to picking away at remaining stock in areas of detail with very small cutters. Any other method would produce poor surface finish or cause cutters to break unnecessarily.

Parallel pencil milling is an extension of pencil milling, in that the user can determine the number and step-over of multiple-passes either side of the pencil toolpath.

This is particularly useful when the previous cutting tool has not been able to machine all the internal corner radii to size. These multiple passes, will machine the remaining internal radii and any additional material left by the previous cutting tool, machining from the outside into the corner. This creates a good surface finish to the true form and can be used in conjunction with cutter contact angles.

NCG CAM for General Purpose Milling Machines

Although written for HSM, one of the most important features of **NCG CAM** is that most of the features designed for HSM can be applied to more general purpose milling machines to reduce air cutting, improve cycle times and improves the surface finish quality.

Adopting NCG CAM on the Shop-floor Reduces Machining Lead Times by up to 95% for Dynamic Die & Steel (Sheffield) Ltd

About the Company

Established since 1970, Dynamic Die & Steel (Sheffield) Ltd, Sheffield, UK, provide a complete sub-contract solution, specialising in medium to heavy machining of large forge tooling for a variety of industries including aerospace, mining and transportation.

Requirements

Dynamic Die & Steel (Sheffield) Ltd were looking for a shop-floor CAM system suitable for their high speed machining centres, that would address the rapid turn around required when producing very large forging die tools.

Results from Purchasing NCG CAM

- ✓ Machining lead times have been significantly reduced from 8 weeks down to just 2 days
- ✓ Operators can make modifications straight away, by using the software on the shop-floor, saving time
- ✓ The amount of benching has been minimised , as the smooth cutter paths produced by **NCG CAM** give excellent surface finish
- ✓ Training of additional staff is no longer an issue, as **NCG CAM** is so easy to use

"NCG CAM is a very powerful 3D programming system. The speed with which we create the very large cutter paths required in the production of 2 metre die impressions is incredible and has enabled us to operate lights out machining on our high speed machine tools.
Most of all, our customers have been astounded by how quickly we can turn round a suite of tools, which allows us to keep our pricing very competitive."

- Andy Farmer, Managing Director, Dynamic Die & Steel (Sheffield) Ltd

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NCG CAM Solutions Ltd.

Somers Forge Increase Productivity up to 10 X by Utilising NCG CAM for Shop-Floor Programming

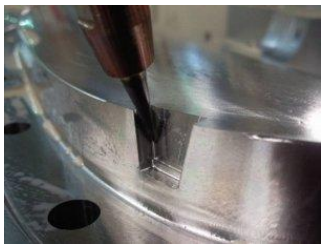
About the Company

With over 130 years experience in heavy engineering, Somers Forge, West Midlands, UK is one of the leading open die forge masters in Europe, working in a variety of materials ranging from carbon steel through to super alloys and specialised nonferrous alloys.

Somers Forge satisfies a wide range of requirements for world industry using its comprehensive in-house facilities, including marine, power, oil, defence and aerospace and are exploring more avenues such as mould & die machining.

Requirements

Somers Forge was looking for an easy to use, reliable CAM software package suitable for shop floor programming, that was compatible with SolidWorks and their DEPO machine tools.



***Right** - Using 3+2 with small cutters to minimise spark erosion*

Results from Purchasing NCG CAM

- ✓ Introducing CNC machines with **NCG CAM**, allows drilling & milling on the same machine tool and by using the 3+2 eliminates further operations on parts. Jobs have been reduced from 300 hours to just under 30 hours.
- ✓ Simple to program at the machine tool, allowing users to open the model and create the program in minimal time.
- ✓ Ease of use and reliability of **NCG CAM** means users are confident running lights out machining, saving valuable time.
- ✓ Easily able to diversify the type of work that they offer from forgings to mould tools.
- ✓ Able to dedicate one machine tool to roughing and carry on with other operations on the other machine, such as rest roughing, 3+2 axis and trimming back to stock models, so utilising both machines to their maximum capacity.
- ✓ Drilling is very good for drilling multiple holes; it takes just a few mouse clicks to drill 500 holes.
- ✓ Easy to drill multiple holes that have different depths, but the same diameter, using just one command.
- ✓ When drilling using 3+2 axis, do not need to worry about the angle of the hole, as **NCG CAM** always finds the correct place.

"Somers Forge has established an international reputation for successfully combining the very best technology, such as NCG CAM, with traditional quality skills."

Stephen Abbott, CNC Supervisor

SOMERS

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