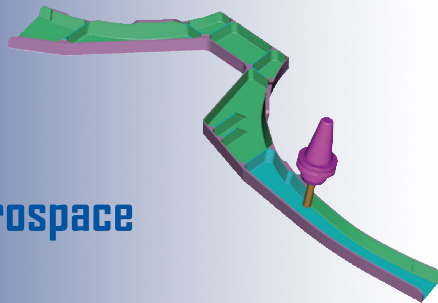




The Ultimate 5-axis CAM Solution

5 axis Simultaneous Contouring Applications

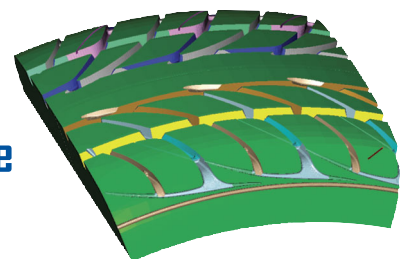
Aerospace



Turbomachinery



Automotive



NUMERICAL
CONTROL
COMPUTER
SCIENCES

The Ultimate 5-axis

"As leaders in the machining of aircraft components, we are committed to meeting the challenges of the 21st Century. They are met with technological advances in equipment and CAD/CAM technology such as the highly sophisticated 5-axis NCL/CAM software. Our goal to expand our expertise has led to much growth and new opportunities."

- Dave Olsen
Hydro-Mill Company

NCL Multi-axis Machining Software

NCL is a powerful Computer-Aided Manufacturing system designed to provide a maximum degree of flexibility in creating tool paths to produce machined parts of any complexity.

NCL offers a unique blend of automated and user-controlled tool path generation techniques that result in reduced programming time and increased quality.

NCL's combination of power, flexibility and tool control will give you a distinct advantage over your competition by allowing you to quickly produce any part, reduce machine time, improve quality, and increase profits.

Multi-axis

NCL sets the standard for 4- and 5-axis tool path generation; there simply is no better solution

Flank milling options include:

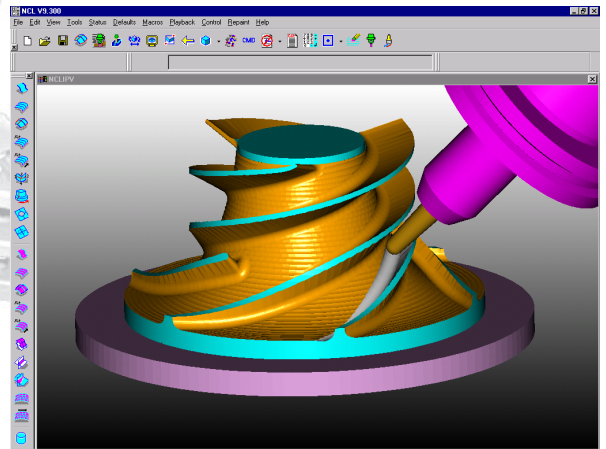
- ▶ Parallel to iso-lines
- ▶ Perpendicular to floor and tangent to drive surface
- ▶ Fanning from surface to surface
- ▶ Combined fanning and iso-line machining
- ▶ Combined fanning and perpendicular to floor/tangent to drive surface
- ▶ Guide curve avoid option
- ▶ Apply tilt and slew angles
- ▶ Specify a lock-out vector for 4-axis simultaneous machining

Bottom milling options include:

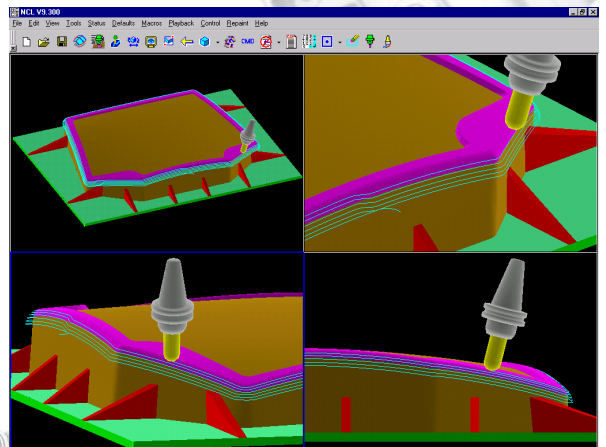
- ▶ Normal to surface being machined
- ▶ Normal to a control surface while machining other surfaces
- ▶ Automatic gouge avoidance
- ▶ Apply tilt and slew angles
- ▶ Specify a lock-out vector for 4-axis simultaneous machining

Special modes:

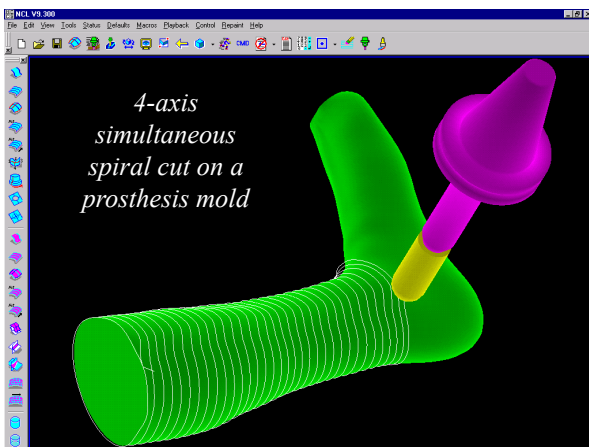
- ▶ Automatically lock the tool axis when generating corners
- ▶ Tool axis passing through a point
- ▶ Tool axis passing through a 3D curve
- ▶ Interpolation between a start and end vector



5-axis flank milling on a high-wrap impeller



5-axis machining normal to a control surface while cutting other surfaces on an automotive die



4-axis
simultaneous
spiral cut on a
prosthesis mold

s CAM Solution

"As Manager of Production Systems Support for Elliott Turbomachinery, my job is to make sure we select the right software for the job and to keep the systems up and running. Two things are very important to me, 1) quality of product and 2) support from the vendor. NCCS has created an exceptional product and their service has always been outstanding."

- Dave Hayden
Elliott Turbomachinery

Roughing

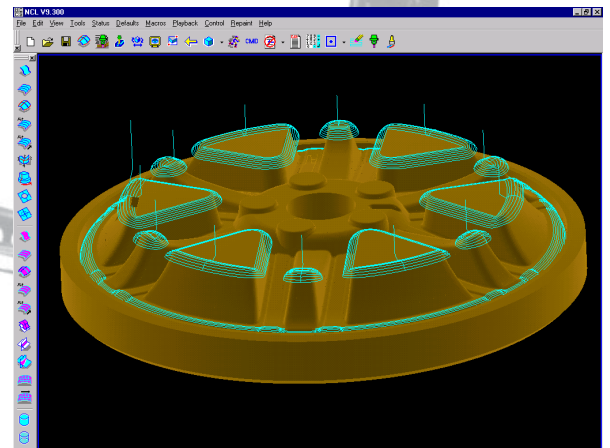
NCL's automated roughing is fast, efficient and easy-to-use

- ▶ Quickly roughs large imported models
- ▶ Recognizes stock and part geometry
- ▶ Stock models can be included with the model to be machined or the system will automatically calculate a contour or rectangular stock model
- ▶ The user can specify the bottom and top levels or the system will automatically calculate the extent of the area to machine
- ▶ Machine the entire model or only a selected portion of the model
- ▶ Machine the model from any tool axis orientation
- ▶ The tool path is fully associative. Simply open a new model containing engineering changes and regenerate the tool path
- ▶ The roughing parameters can be saved as a template that can be used to quickly machine similar components

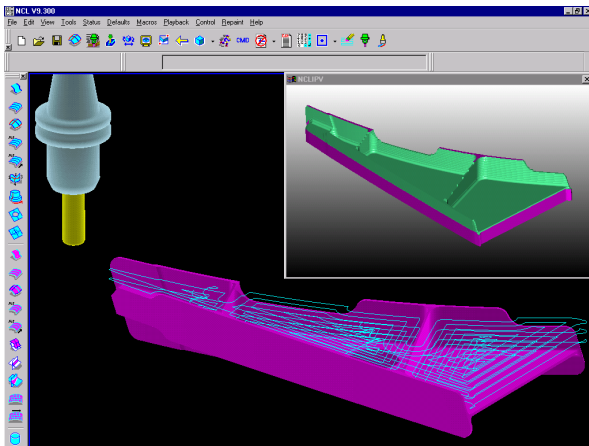
Pocketing

High-production pocketing quickly generates efficient tool paths

- ▶ Entry methods include: user-defined, plunge, ramp, and helical
- ▶ Choose between multiple entry locations or a single entry location
- ▶ Automatically define pre-drilled entry locations
- ▶ Machine from the inside out or outside in
- ▶ Automatically arc all sharp corners for HSM
- ▶ Machine all pockets at a constant z-level or machine to depth one pocket at a time



Flow line machining fillets on a hubcap die

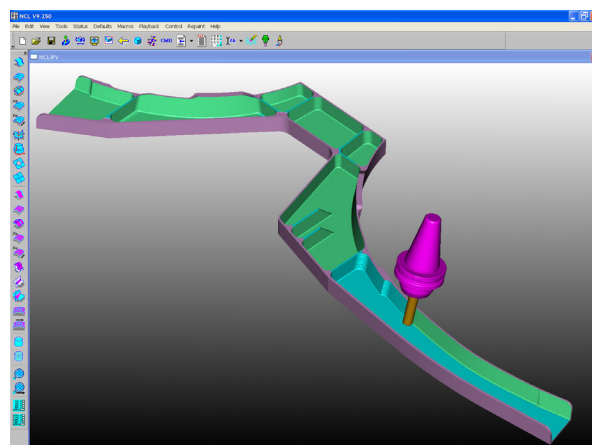


Z-level roughing of an airframe part consisting of multiple-depth pockets and angled flanges

Contouring

User controlled contouring allows you to go anywhere you want on the part

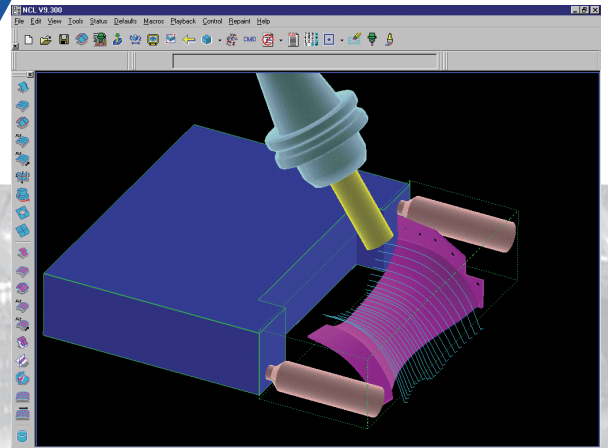
- ▶ User defined entry and exit locations
- ▶ Automatic arc generation in corners and on entry and exit
- ▶ Slowdown and acceleration feedrate control
- ▶ Contour using one of many multi-axis control modes



5-axis contouring on a typical airframe part

*"We use the **NCL** macro language to automate the production of tire models. **NCL** gives us the ability to create custom macros to standardize everything from building 2D to 3D models to creating reusable tool paths for tire lines. **NCL** also gives us strong control over tool vectors when driving the tool around the model. Adding shrink in the post processing stage simplifies the tooling process. The major limiting factor using **NCL** is your imagination."*

- Paul Baker
Quality Mold Shop



4-axis simultaneous lead-angle spiral cut on a jet engine vane

Material remaining

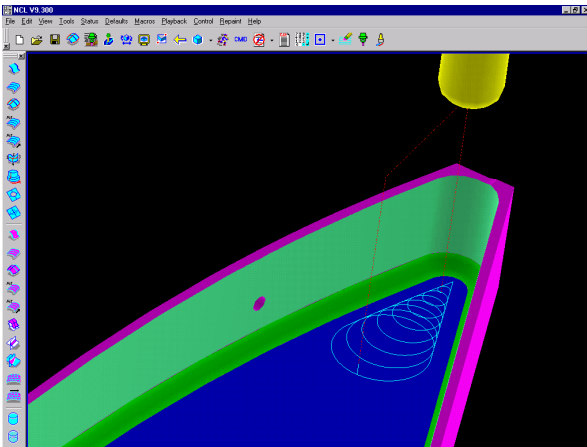
Smoothly carve away excess material in corners and undercut areas

- ▶ Cleanly whittle away material left by a previous tool using a series of decreasing circular moves
- ▶ Using a variable tool axis strategy, efficiently machine away material left in undercut areas

Regional milling

Fast and flexible multi-axis regional milling

- ▶ Lace and non-lace cutting strategies
- ▶ Constant scallop or fixed distance step over options
- ▶ Optionally generate finish pass around region
- ▶ Supports a variety of multi-axis control modes



Carving away material left in the corner by a previous tool

Flowline milling

Smooth finishing along surface iso-lines

- ▶ Supports trimmed and non-trimmed surfaces
- ▶ User specified starting point and cut direction
- ▶ Scallop height and fixed distance step over options
- ▶ Machine to surface boundaries or specify a boundary

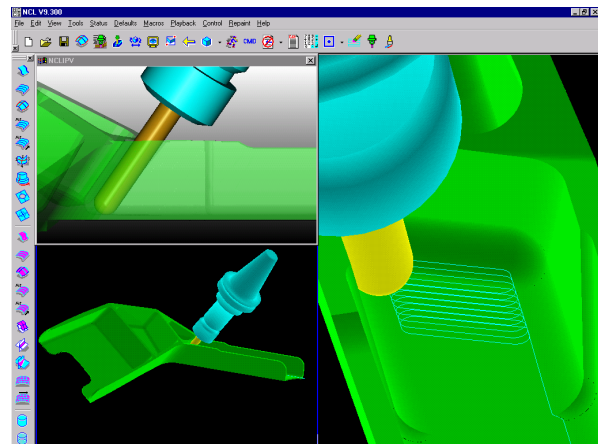
Hole making

From manual picking to complete automation, hole making couldn't be faster

- ▶ Point, click and drill a single hole or a pattern of holes
- ▶ Import a file containing hole locations and automatically perform a series of hole operations at each location
- ▶ Graphically simulate and output all standard cycles
- ▶ Special 'point-vector' entity makes multi-axis hole operations simple
- ▶ Pattern definition and arrays make it easy to optimize and perform operations on large numbers of holes
- ▶ Helical and circular boring operations

Feedrate control

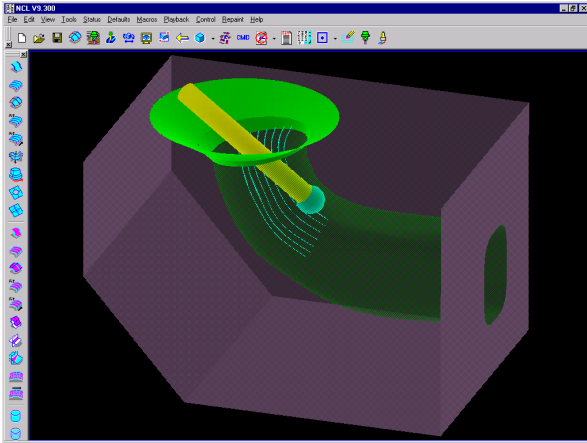
- ▶ Full control of approach, entry, machining, transition, and retract feedrates
- ▶ During sequential milling the user can specify a different feedrate for each individual cut
- ▶ Automatic slowdown and acceleration feedrate control in corners
- ▶ Automatically calculates true-surface feedrate when generating arcs



5-axis machining of an undercut area on an airframe part

Associativity

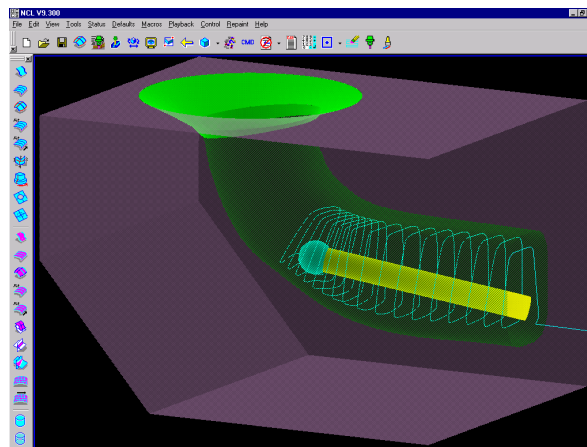
- ▶ Geometric models can be created using associativity and can be parametrically driven by a table of variables. Ideal for part families and incorporating engineering changes
- ▶ Tool paths are associated with the geometric model. A change to the model results in an immediate change to corresponding tool paths
- ▶ An imported model can be mathematically compared to a previously machined model. Differences are clearly identified and the original tool paths can be re-applied to the new model



5-axis positioning and 3-axis plunge milling along flow lines of an intake port

Opposite hand parts

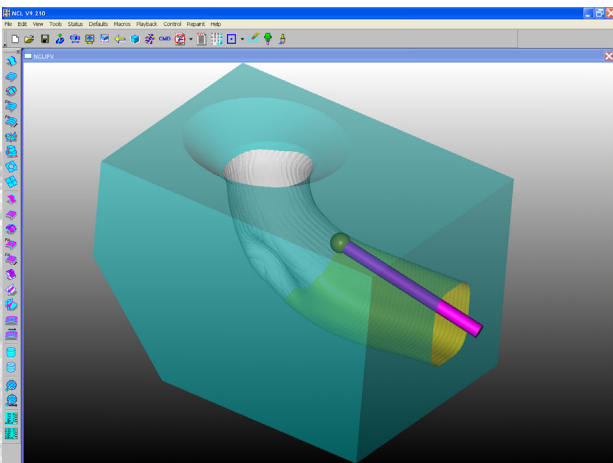
- ▶ Mirror the part and simply re-apply automated tool paths
- ▶ User-defined sequential tool paths can be automatically reversed to retain original cut direction



5-axis "through-a-point" spiral milling of an intake port

Knowledge

Machining strategies, tool selections, feeds and speeds and more can be saved and applied to future projects. Advanced programmers can define the best practices for your organization and beginning programmers can use the saved knowledge to produce expert and consistent results



Simulated results of 5-axis "through-a-point" spiral milling of an intake port

The Best of the Best

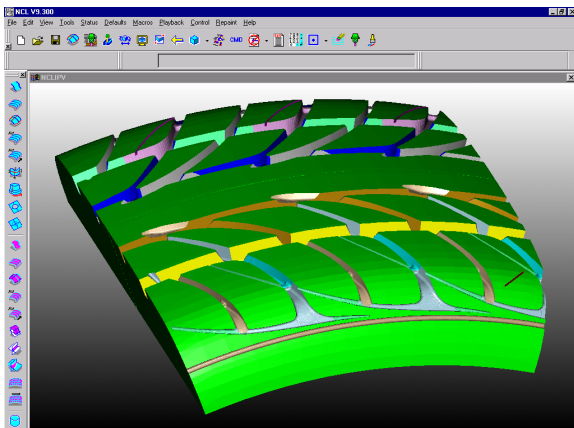
A partial list of some of the best manufacturing companies in the world, that use **NCL**

- ✖ AGM Engineering
- ✖ Advanced Turbine Components
- ✖ Air Industries
- ✖ Arden Engineering
- ✖ Ashley Machine
- ✖ B/E Aerospace
- ✖ BAE Aerospace
- ✖ BF Goodrich
- ✖ Boeing
- ✖ Bombardier
- ✖ Brek Manufacturing
- ✖ British Aerospace
- ✖ Capy Machine
- ✖ Chester Tire Mold
- ✖ Contour Aerospace
- ✖ Cooper Tire
- ✖ Daimler Benz Aerospace
- ✖ Danner Corporation
- ✖ Dasco Engineering
- ✖ Deutsche Airbus
- ✖ Elliott Company
- ✖ General Mechatronics
- ✖ Hallmark Tools
- ✖ Harlow Aircraft
- ✖ Hawker De Havilland
- ✖ Hicksville Machine
- ✖ HM Dunn
- ✖ Hydro-Mill
- ✖ Integrated Aerospace
- ✖ Lockheed-Martin
- ✖ Merritt Tool Company
- ✖ Stellex Monitor Aerospace
- ✖ Neuvant Aerospace
- ✖ Northrop Grumman
- ✖ Paragon Precision
- ✖ Precision Components Intl.
- ✖ Quality Mold
- ✖ Ralee Engineering
- ✖ Rolls Royce, Corp.
- ✖ Techneglas
- ✖ Thayer Aerospace
- ✖ Tire Tread Development
- ✖ Tru-Circle Aerospace
- ✖ United Defense
- ✖ Waldens Machine
- ✖ Wilson Products

Macros

NCL's macro capability is powerful, comprehensive and easy-to-use. The use of macros can infinitely expand your manufacturing capabilities

- ▶ Easy to follow prompts can be associated to macro input variables
- ▶ The system automatically generates a form style interface for each macro complete with prompts, toggle fields, and the ability to graphically select entities from the screen
- ▶ Macros can contain any **NCL** geometry and tool path creation command
- ▶ Macros support full programmatic looping logic including IF-THEN-ELSE and DO loops
- ▶ Macros can be stored in a shared folder and accessed by any **NCL** user on the network
- ▶ Macro calls can be initiated from a list box, a hot key or a menu pick



5-axis machining of a tire mold pattern

Application Libraries

General-purpose CAM solutions may not always address the unique requirements of your application. That is why NCCS has developed a suite of special Application Libraries that provide manufacturing solutions for specific applications. Libraries are currently available for the following applications:

- ▶ Structural aerospace components
- ▶ Turbo-machinery: airfoils, blisks and impellers
- ▶ Tire molds
- ▶ Port machining

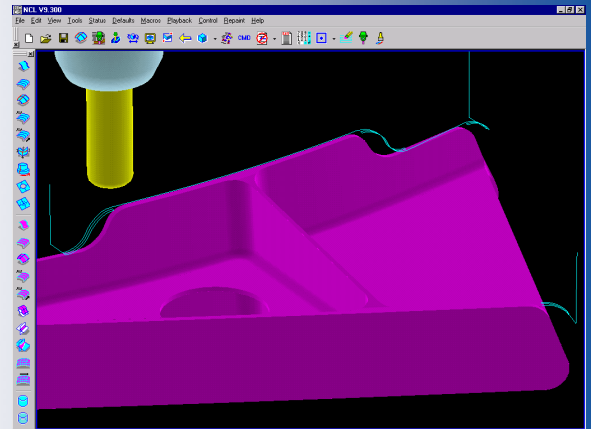
The Package

Every seat of **NCL** includes the following capabilities:

- ▶ Parametric modeling
- ▶ Model importation
- ▶ Simultaneous 2- through 5-axis tool path generation
- ▶ Annotation and dimensioning
- ▶ 5-axis postprocessor generator and postprocessor library
- ▶ Aerospace Application Library

Upgrades to the base package include:

- ▶ Integrated tool path verification, simulation, and inspection
- ▶ 10-axis postprocessor
- ▶ 2 through 4 axis turning
- ▶ Mill/Turn
- ▶ Direct translators for CATIA and UG



Finish machining of flange top surfaces on an airframe part

Advanced postprocessing

Not just any postprocessor! Each **NCL** license comes with a full-blown license of **PastWorks**, NCCS' industry leading universal postprocessor. Use or modify a post from the library or configure your own post from scratch. With **PastWorks** it is easy to configure a multi-axis machine. The **PastWorks** library comes with pre-configured posts for some of the most popular controls including FANUC, Heidenhain, and Siemens.

Interface

NCL employs a familiar Windows-style interface that is intuitive, customizable and efficient

- ▶ Fast Open/GL graphics
- ▶ Change the initial screen layout by simply dragging and dropping menus and toolbars to the desired location
- ▶ **NCL's** record/playback feature allows you to record a series of keystrokes and menu selections that can be played back later with a single mouse click or keystroke
- ▶ Easily modify system modals and default settings
- ▶ All **NCL** functions, macros record/playback files and even operating system commands can be assigned to a hotkey or a menu

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