CNC

From Wikipedia, the free encyclopedia

A CNC Turning Center


A CNC Milling Machine

The abbreviation **CNC** stands for **computer numerical control**, and refers specifically to a computer "controller" that reads G-code instructions and drives the machine tool, a powered mechanical device typically used to fabricate metal components by the selective removal of metal. CNC does numerically directed interpolation of a cutting tool in the work envelope of a machine. The operating parameters of the CNC can be altered via software load program.

NC was developed in the late 1940s and early 1950s by John T. Parsons in collaboration with the MIT Servomechanisms Laboratory (http://libraries.mit.edu/archives/mithistory/histories-offices/servo.html). CNC was preceded by NC (Numerically Controlled) machines, which were hard wired and their operating parameters could not be changed. The first CNC systems used NC style hardware, and the computer was used for the tool compensation calculations and sometimes for editing.

Punched tape continued to be used as a medium for transferring G-codes into the controller for many decades after 1950, until it was eventually superseded by RS232 cables, floppy disks, and finally standard computer network cables. The files containing the G-codes to be interpreted by the controller are usually saved under the .NC extension. Most shops have their own saving format that matches their ISO certification requirements.

The introduction of CNC machines radically changed the manufacturing industry. Curves are as easy to cut as straight lines, complex 3-D structures are relatively easy to produce, and the number of machining steps that required human action have been dramatically reduced.

With the increased automation of manufacturing processes with CNC machining, considerable improvements in consistency and quality have been achieved. CNC automation reduced the frequency of errors and provided CNC operators with time to perform additional tasks. CNC automation also allows for more flexibility in the way parts are held in the manufacturing process and the time required to change the machine to produce different components.

In a production environment, a series of CNC machines may be combined into one station, commonly called a "cell", to progressively machine a part requiring several operations. CNC machines today are controlled directly from files created by CAM software packages, so that a part or assembly can go directly from design to manufacturing without the need of producing a drafted paper drawing of the manufactured component. In a sense, the CNC machines represent a special segment of industrial robot systems, as they are programmable to perform many kinds of machining operations (within their designed physical limits, like other robotic systems). CNC machines can run over night and over weekends without operator intervention. Error detection features have been developed, giving CNC machines the ability to call the operator's mobile phone if it detects that a tool has broken. While the machine is awaiting replacement on the tool, it would run other parts it is already loaded with up to that tool and wait for the operator. The ever changing intelligence of CNC controllers has dramatically increased job shop cell production. Some machines might even make 1000 parts on a weekend with no operator, checking each part with lasers and sensors.

Contents

Types of instruction

A line in a G-code file can instruct the machine tool to do one of several things.

Movements

The most basic motion for a controller is to move the machine tool along a linear path from one point to another.[1] Some machine tools can only do this in XY, and have to accept changes in Z separately. Some have two further axes of rotation to control the orientation of the cutter, and can move them simultaneously with the XYZ motion. Lately 4, and 5 axis machines have become popular. The 2 additional axies allow for the work surface or medium to be rotated around X and Y. For example, a 4-axis machine can move the tool head in XY and Z directions, and also rotate the medium around the X or Y axis, similar to a lathe.This is called the A or B axis in most cases.

All motions can be built from linear motions if they are short and there are enough of them. But most controllers can interpolate horizontal circular arcs in XY. See CNC circular arc motions for further details.

Lately, some controllers have implemented the ability to follow an arbitrary (NURBS) curve, but these efforts have been met with skepticism since, unlike circular arcs, their definitions are not natural and are too complicated to set up by hand, and CAM software can already generate any motion using many short linear segments.

Tool changes

Originally there would be a G-code instruction telling the machine tool to stop so that a human operator could remove the cutting tool from the chuck and insert a new one. Modern machine tools have a magazine of different tools which they can change themselves pneumatically, hydraulically, and electromechanically.

On newer models of CNC Machines such as Mori Seiki designs, depending on which tool would be used, assuming it's tool 4 the procedure for an idle machine tool change would be;

MDI,

T4; M6;

There are related instructions such as setting the spindle speed, and turning on or off the coolant.

Drilling

A tool can be used to drill holes by pecking to let the swarf out. Using a special tapping tool and the ability to control the exact rotational position of the tool with the depth of cut, it can be used to cut screw threads.

Drilling cycles

A drilling cycle is used to repeat drilling or tapping operations on a workpiece. The drilling cycle accepts a list of parameters about the operation, such as depth and feed rate. To begin drilling any number of holes to the specifications configured in the cycle, the only input required is a set of coordinates for hole location. The cycle takes care of depth, feed rate, retraction, and other parameters that appear in more complex cycles. After the holes are completed, the machine is given another command to cancel the cycle, and resumes operation.

Parametric programming

A more recent advancement in CNC interpreters is support of logical commands, known as parametric programming. Parametric programs incorporate both G-code and these logical constructs to create a programming language and syntax similar to BASIC. Various manufacturers refer to parametric programming in brand-specific ways. For instance, Haas refers to parametric programs as macros. GE Fanuc refers to it as Custom Macro A & B. While Okuma refers to it as User Task 2. The programmer can make if/then/else statements, loops, subprogram calls, perform various arithmetic, and manipulate variables to create a large degree of freedom within one program. An entire product line of different sizes can be programmed using logic and simple math to create and scale an entire range of parts, or create a stock part that can be scaled to any size a customer demands.

Parametric programming also enables custom machining cycles, such as fixture creation and bolt circles. If a user wishes to create additional fixture locations on a work holding device, the machine can be manually guided to the new location and the fixture subroutine called. The machine will then drill and form the patterns required to mount additional vices or clamps at that location. Parametric programs are also used to shorten long programs with incremental or stepped passes. A loop can be created with variables for step values and other parameters, and in doing so remove a large amount of repetition in the program body.

Because of these features, a parametric program is more efficient than using CAD/CAM software for large part runs. The brevity of the program allows the CNC programmer to rapidly make performance adjustments to looped commands, and tailor the program to the machine it is running on. Tool wear, breakage, and other system parameters can be accessed and changed directly in the program, allowing extensions and modifications to the functionality of a machine beyond what a manufacturer envisioned.

There are three type of variable used in CNC sysyem such as Local varaible, Common varible , System varaible. Local varible is hold data after machine off preset value. Second one common varible is used hold data if machine swich off dosenot erase for data.Third one Systm varible this varible used system parameter this canot use direct to convet the coomom varible examplle Tool radius, Tool length Heiden Control G code

Tools with CNC variants

- Drills

- EDMs
- Lathes
- Milling machines
- Wood routers
- Sheet metal works
- Hot-wire foam cutters
- Plasma cuttings
- Water jet cutters
- Laser cutting
- Oxy-fuel

See also

- Computer-aided design (CAD)
- Computer-aided engineering (CAE)
- Computer-aided manufacturing (CAM)
- G-code
- Numerical control
- Machine tool
- Tooling University (offers online CNC training classes)
- Coordinate-measuring machine (CMM)
- Robert C. Byrd Institute CNC training and education.

External links

- Fundamentals Of CNC (http://www.cncci.com/resources/articles/CNC%20basics%201.htm)
- Introduction to CNC Metal Spinning Techniques (http://www.franjometal.com/metal-spinning/cnc-metal-spinning.html)
- Flow Forming and Shear Forming w/ CNC (http://www.franjometal.com/metal-spinning/flow-forming.html)
- CNC Machining in UK (http://www.lmrgeartech.com/)
- High Speed Milling (http://www.cnc-academy.com/cnc-programming-articles/cnc-programming-articles.htm)
- The Enhanced Machine Controller (http://www.linuxcnc.org/), opensource CNC control software
- MyNC Numerical Control System (http://mync.sourceforge.net/), opensource CNC software
- CNC Machining in Taiwan (http://www.takumi.com.tw/)
- CandyFAB: Machining with Sugar (http://www.evilmadscientist.com/article.php/candyfab)
- See CNC Machining in Action (http://www.composidie.com/about/video-vault.html)

Footnotes

1. ^ From Mr. Steven Watterson, a teacher of the PLTW class at a career center. The location of this career center was not mentioned by the contributing editor.

Metalworking:	
CNC, CAD, and CAM:	2.5D | CAD | CAE | CAM | **CNC** | G-code | Numerical control | Stewart platform

Metalworking topics:	Casting | **CNC** | Cutting tools | Drilling and threading | Fabrication | Finishing | Grinding | Jewellery | Lathe (tool) | Machining | Machine tooling | Measuring | Metalworking | Hand tools | Metallurgy | Milling | Occupations | Press tools | Smithing | Terminology | Welding

Categories: Automation | CNC, CAD, and CAM | Embedded systems | Machine tools | Production and manufacturing

Shortcut Text	Internet Address
continued donations	http://wikimediafoundation.org/wiki/Fundraising
navigation	http://en.wikipedia.org/wiki/CNC#column-one
search	http://en.wikipedia.org/wiki/CNC#searchInput
CNC (disambiguation)	http://en.wikipedia.org/wiki/CNC_(disambiguation)
	http://en.wikipedia.org/wiki/Image:Small_CNC_Turning_Center.jpg
	http://en.wikipedia.org/wiki/Image:Vertikalbearbeitungszentrum_Hermle_C_30_U.jpg
G-code	http://en.wikipedia.org/wiki/G-code
machine tool	http://en.wikipedia.org/wiki/Machine_tool
John T. Parsons	http://en.wikipedia.org/wiki/John_T._Parsons
MIT Servomechanisms Laboratory	http://libraries.mit.edu/archives/mithistory/histories-offices/servo.html
NC	http://en.wikipedia.org/wiki/Numerical_control
RS232 cables	http://en.wikipedia.org/wiki/RS232
floppy disks	http://en.wikipedia.org/wiki/Floppy_disks
computer network cables	http://en.wikipedia.org/wiki/Computer_network
ISO certification requirements	http://en.wikipedia.org/wiki/International_Organization_for_Standardization
manufacturing	http://en.wikipedia.org/wiki/Manufacturing
machining	http://en.wikipedia.org/wiki/Machining
CAM	http://en.wikipedia.org/wiki/Computer-aided_manufacturing
software	http://en.wikipedia.org/wiki/Software
industrial robot	http://en.wikipedia.org/wiki/Industrial_robot
hide	javascript:toggleToc()
1 Types of instruction	http://en.wikipedia.org/wiki/CNC#Types_of_instruction
1.1 Movements	http://en.wikipedia.org/wiki/CNC#Movements
1.2 Tool changes	http://en.wikipedia.org/wiki/CNC#Tool_changes
1.3 Drilling	http://en.wikipedia.org/wiki/CNC#Drilling
1.4 Drilling cycles	http://en.wikipedia.org/wiki/CNC#Drilling_cycles
1.5 Parametric programming	http://en.wikipedia.org/wiki/CNC#Parametric_programming
2 Tools with CNC variants	http://en.wikipedia.org/wiki/CNC#Tools_with_CNC_variants
3 See also	http://en.wikipedia.org/wiki/CNC#See_also
4 External links	http://en.wikipedia.org/wiki/CNC#External_links
5 Footnotes	http://en.wikipedia.org/wiki/CNC#Footnotes
edit	http://en.wikipedia.org/w/index.php?title=CNC&action=edit§ion=1
edit	http://en.wikipedia.org/w/index.php?title=CNC&action=edit§ion=2
[1]	http://en.wikipedia.org/wiki/CNC#_note-0
lathe	http://en.wikipedia.org/wiki/Lathe

Shortcut Text	Internet Address
circular arcs	http://en.wikipedia.org/wiki/Circular_arc
CNC circular arc motions	http://en.wikipedia.org/w/index.php?title=CNC_circular_arc_motions&action=edit
arbitrary (NURBS)	http://en.wikipedia.org/wiki/Nonuniform_rational_B-spline
edit	http://en.wikipedia.org/w/index.php?title=CNC&action=edit§ion=3
edit	http://en.wikipedia.org/w/index.php?title=CNC&action=edit§ion=4
swarf	http://en.wikipedia.org/wiki/Swarf
edit	http://en.wikipedia.org/w/index.php?title=CNC&action=edit§ion=5
edit	http://en.wikipedia.org/w/index.php?title=CNC&action=edit§ion=6
BASIC	http://en.wikipedia.org/wiki/BASIC
Heiden Control	http://en.wikipedia.org/w/index.php?title=Heiden_Control&action=edit
G code	http://en.wikipedia.org/w/index.php?title=G_code&action=edit
edit	http://en.wikipedia.org/w/index.php?title=CNC&action=edit§ion=7
Drills	http://en.wikipedia.org/wiki/Drill
EDMs	http://en.wikipedia.org/wiki/Electrical_discharge_machining
Lathes	http://en.wikipedia.org/wiki/Lathe_(tool)
Milling machines	http://en.wikipedia.org/wiki/Milling_machine
Wood routers	http://en.wikipedia.org/wiki/CNC_wood_router
Sheet metal works	http://en.wikipedia.org/wiki/Sheet_metal
Hot-wire foam cutters	http://en.wikipedia.org/wiki/Hot-wire_foam_cutter
Plasma cuttings	http://en.wikipedia.org/wiki/Plasma_cutting
Water jet cutters	http://en.wikipedia.org/wiki/Water_jet_cutter
Laser cutting	http://en.wikipedia.org/wiki/Laser_cutting
Oxy-fuel	http://en.wikipedia.org/wiki/Oxy-fuel_welding_and_cutting
edit	http://en.wikipedia.org/w/index.php?title=CNC&action=edit§ion=8
Computer-aided design	http://en.wikipedia.org/wiki/Computer-aided_design
Computer-aided engineering	http://en.wikipedia.org/wiki/Computer-aided_engineering
Tooling University	http://en.wikipedia.org/wiki/Tooling_University
Coordinate-measuring machine	http://en.wikipedia.org/wiki/Coordinate-measuring_machine
Robert C. Byrd Institute	http://en.wikipedia.org/wiki/Robert_C._Byrd_Institute
edit	http://en.wikipedia.org/w/index.php?title=CNC&action=edit§ion=9
Fundamentals Of CNC	http://www.cncci.com/resources/articles/CNC%20basics%201.htm
Introduction to CNC Metal Spinning Techniques	http://www.franjometal.com/metal-spinning/cnc-metal-spinning.html
Flow Forming and Shear Forming w/ CNC	http://www.franjometal.com/metal-spinning/flow-forming.html
CNC Machining in UK	http://www.lmrgeartech.com/

Shortcut Text	Internet Address
High Speed Milling	http://www.cnc-academy.com/cnc-programming-articles/cnc-programming-articles.htr
The Enhanced Machine Controller	http://www.linuxcnc.org/
MyNC Numerical Control System	http://mync.sourceforge.net/
CNC Machining in Taiwan	http://www.takumi.com.tw/
CandyFAB: Machining with Sugar	http://www.evilmadscientist.com/article.php/candyfab
See CNC Machining in Action	http://www.composidie.com/about/video-vault.html
edit	http://en.wikipedia.org/w/index.php?title=CNC&action=edit§ion=10
^	http://en.wikipedia.org/wiki/CNC#_ref-0
	http://en.wikipedia.org/wiki/Image:Commons-logo.svg
Wikimedia Commons	http://en.wikipedia.org/wiki/Wikimedia_Commons
CNC	http://commons.wikimedia.org/wiki/Category:CNC
	http://en.wikipedia.org/wiki/Image:Blacksmith_anvil_hammer.svg
Metalworking	http://en.wikipedia.org/wiki/Metalworking
v	http://en.wikipedia.org/wiki/Template:Metalworking_-_CNC,_CAD,_and_CAM
d	http://en.wikipedia.org/w/index.php?title=Template_talk:Metalworking_-_CNC%2C_CAD%2C_and_CAM&action=edit
e	http://en.wikipedia.org/w/index.php?title=Template:Metalworking_-_CNC%2C_CAD2C_and_CAM&action=edit
CNC, CAD, and CAM	http://en.wikipedia.org/wiki/Category:CNC,_CAD,_and_CAM
2.5D	http://en.wikipedia.org/wiki/2.5D
Stewart platform	http://en.wikipedia.org/wiki/Stewart_platform
Casting	http://en.wikipedia.org/wiki/Casting
Cutting tools	http://en.wikipedia.org/wiki/Metalwork_cutting_tool
Drilling and threading	http://en.wikipedia.org/wiki/Drilling_and_threading
Fabrication	http://en.wikipedia.org/wiki/Fabrication_(metal)
Finishing	http://en.wikipedia.org/wiki/Metalworking_finishing
Grinding	http://en.wikipedia.org/wiki/Grinding_machine
Jewellery	http://en.wikipedia.org/wiki/Jewellery
Machine tooling	http://en.wikipedia.org/wiki/Machine_tooling
Measuring	http://en.wikipedia.org/wiki/Metalworking_measurement
Hand tools	http://en.wikipedia.org/wiki/Metalworking_hand_tool
Metallurgy	http://en.wikipedia.org/wiki/Metallurgy
Occupations	http://en.wikipedia.org/wiki/Metalworking_occupation
Press tools	http://en.wikipedia.org/wiki/Machine_press

Shortcut Text	Internet Address
Smithing	http://en.wikipedia.org/wiki/Smith_(metalwork)
Terminology	http://en.wikipedia.org/wiki/Metalworking_terminology
Welding	http://en.wikipedia.org/wiki/Welding
http://en.wikipedia.org/wiki/CNC	http://en.wikipedia.org/wiki/CNC
Categories	http://en.wikipedia.org/wiki/Special:Categories
Automation	http://en.wikipedia.org/wiki/Category:Automation
Embedded systems	http://en.wikipedia.org/wiki/Category:Embedded_systems
Machine tools	http://en.wikipedia.org/wiki/Category:Machine_tools
Production and manufacturing	http://en.wikipedia.org/wiki/Category:Production_and_manufacturing
Discussion	http://en.wikipedia.org/wiki/Talk:CNC
Edit this page	http://en.wikipedia.org/w/index.php?title=CNC&action=edit
History	http://en.wikipedia.org/w/index.php?title=CNC&action=history
Sign in / create account	http://en.wikipedia.org/w/index.php?title=Special:Userlogin&returnto=CNC
	http://en.wikipedia.org/wiki/Main_Page
Contents	http://en.wikipedia.org/wiki/Wikipedia:Contents
Featured content	http://en.wikipedia.org/wiki/Wikipedia:Featured_content
Current events	http://en.wikipedia.org/wiki/Portal:Current_events
Random article	http://en.wikipedia.org/wiki/Special:Random
About Wikipedia	http://en.wikipedia.org/wiki/Wikipedia:About
Community portal	http://en.wikipedia.org/wiki/Wikipedia:Community_Portal
Recent changes	http://en.wikipedia.org/wiki/Special:Recentchanges
File upload wizard	http://en.wikipedia.org/wiki/Wikipedia:Upload
Contact us	http://en.wikipedia.org/wiki/Wikipedia:Contact_us
Help	http://en.wikipedia.org/wiki/Help:Contents
What links here	http://en.wikipedia.org/wiki/Special:Whatlinkshere/CNC
Related changes	http://en.wikipedia.org/wiki/Special:Recentchangeslinked/CNC
Upload file	http://en.wikipedia.org/wiki/Special:Upload
Special pages	http://en.wikipedia.org/wiki/Special:Specialpages
Printable version	http://en.wikipedia.org/w/index.php?title=CNC&printable=yes
Permanent link	http://en.wikipedia.org/w/index.php?title=CNC&oldid=141223339
Cite this article	http://en.wikipedia.org/w/index.php?title=Special:Cite&page=CNC&id=141223339
العربية	http://ar.wikipedia.org/wiki/Ø§Ù□ØªØµÙ□Ù□Ø¹_Ø¨Ø§Ø³ØªØ®Ø¯Ø§Ù□_Ø§Ù□Ø Ø³Ø¨_Ø§Ù□Ø¢Ù□Ù□
Dansk	http://da.wikipedia.org/wiki/CNC-maskine
Deutsch	http://de.wikipedia.org/wiki/Computerized_Numerical_Control
Eesti	http://et.wikipedia.org/wiki/Arvprogrammjuhtimine

Shortcut Text	Internet Address
Esperanto	http://eo.wikipedia.org/wiki/Perkomputile_ciferece_stirata
فارسی	http://fa.wikipedia.org/wiki/Ø³Û□â□□Ø§Ù□â□□Ø³Û□
Italiano	http://it.wikipedia.org/wiki/Computer_numerical_control
Magyar	http://hu.wikipedia.org/wiki/CNC
Nederlands	http://nl.wikipedia.org/wiki/CNC
□□□	http://ja.wikipedia.org/wiki/CNC
Polski	http://pl.wikipedia.org/wiki/CNC
Português	http://pt.wikipedia.org/wiki/CNC
Svenska	http://sv.wikipedia.org/wiki/CNC
Tiếng Việt	http://vi.wikipedia.org/wiki/CNC
Türkçe	http://tr.wikipedia.org/wiki/CNC
□□	http://zh.wikipedia.org/wiki/CNC
	http://www.mediawiki.org/
	http://wikimediafoundation.org/
GNU Free Documentation License	http://en.wikipedia.org/wiki/Wikipedia:Text_of_the_GNU_Free_Documentation_Lice
Copyrights	http://en.wikipedia.org/wiki/Wikipedia:Copyrights
Wikimedia Foundation, Inc	http://www.wikimediafoundation.org/
501(c)(3)	http://en.wikipedia.org/wiki/501(c)#501.28c.29.283.29
tax-deductible	http://wikimediafoundation.org/wiki/Deductibility_of_donations
nonprofit	http://en.wikipedia.org/wiki/Non-profit_organization
charity	http://en.wikipedia.org/wiki/Charitable_organization
Privacy policy	http://wikimediafoundation.org/wiki/Privacy_policy
Disclaimers	http://en.wikipedia.org/wiki/Wikipedia:General_disclaimer