

COMPUTER NUMERICAL CONTROL(CNC)

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Abstract: The ideal aim in industry is high-speed quantitative production at low costs with the tremendous advances in electronic equipment, mechanics became associated with electronic science. Automatic control is possible in different production areas. With the increase of more complex products, CNC machine was invented. The CNC machine was invented and a new industrial renaissance took place after this invention. Today, most of the factories work according to this technique. One of the reasons for today's development is computer numerical control.

Keywords: CNC, CAD, CAM, GODE.

INTRODUCTION

The invention of operating machines was a milestone in the history of mankind to replace human. These machines manufacture instead of human and the efficiency is higher and accuracy of course will be better and instead of using the number of hand tools it seemed about a year 1775 A. D [1]. When the cylinder cavity machine was invented to manufacture the James Watt steam machine. Since then it led to the introduction in large quantities to the development of machine tool in order to produce the highest accuracy of mass production in the century 20 AD [2]. The mass production was applied practically intensively in the assembly of Ford car machines in 1913 in the United States of America. Since then this method of Mass production has been known with high efficiency [3]. The tremendous progress in electronic equipment so that automatic control became possible in various productive areas and this was called automation, while the appearance of machines was called mechanization [4]. Shortly after World War II, with the increase of more complex products, the CNC machine was invented to effectively reduce the urgent need for skilled workers to operate manufacturing systems. Since the 1950s several Scientific and technical developments were one of the most prominent inventions of the computer in the form of the spine for the development of several industrial technologies of digital control and reboot and the manufacture of computer support cam [5]. In this introduction, we try to present the historical developments that have accompanied the development of digital control technology and identify the differences between traditional number machines and digital control number machines, as well as to demonstrate the technical and economic feasibility of using

digital control machines. It is useful to determine from the beginning that the focus will be entirely on the application of digital computer control technology on number machines. The considering that this is the historical area in which it appeared, and also the most important area for production technology, although there are other applications for this technology. Before starting to deal with this technology and establish the necessary drivers, it is necessary to identify the framework in which the digital computer control technology works, and when to use it economically and technically, this confirms the importance of this introduction.

METHOD

In this article we will explain general overview of all kind of CNC machines. and we will mention about its concept as well as why it was named by that name. and Why all factories use CNC today. We will find the difference between method of classic production and CNC. We will mention about Stages of work and how is working CNC, also its relationship to CAD/CAM. We will mention about concept of CAD/CAM and languages of CNC G Code. finally, we will overview the advantages and disadvantages of the mechanism of CNC. also, its relationship to digital control and the way to take commands from the computer and sending of commands to the tools cutting.

The concept of CNC

Digital control machines are machining whose tasks are controlled so that the functions of operating them are arranged through letters, symbols and numbers all formed to be called the driver has been named CNC because it contains the computer and machine and the switching device between the two. The meaning of digital control machines is the connection of the computer to the machine and there is between them a translator device to know them some or as we say interface and of course the machine does not know the language of the computer and that is why we put this device [6].

COMPUTER	NUMERICAL	CONTROL
C	N	C

The CNC consists of three parts:

- Machine (which is the operation).
- Control (which is responsible for controlling machine engines).
- Computer (and the function of the computer we write on it the program dedicated to the machine and save the programs on its allocated memory).

Types of CNC machines

The strength of CNC machines comes from their ability to handle different types of materials with high precision. Unlike other machines, digital control machines have proven their efficiency in handling thick materials and can easily penetrate them. CNC machines can also handle fine details, for example cutting the letter V may not be easy for other machines to deal with such work that requires precision, but this cut will be easy if using CNC .Digital control machines have many advantages and deal with various materials such as wood and other materials, and this versatility has led to the existence of more than one type of CNC machines[11]:

a) CNC routers

CNC routers cut wood, plastic, and also sheet metal, and have three-dimensional axes in the manufacture for bulky products and Complex products. And using for cutting different materials along a path. the figure1 Is the shape of the CNC router



Figure 1: CNC routers

b) Water Jet Cutting

A cutting system used in CNC machines, a cold cut system that is not polluted for the environment, is cut by pumping water and uses this technique with any kind of soft or harsh material such as metal, glass and ceramics. the figures 2 Is the shape of the Water Jet Cutting.



Figure 2: Water Jet Cutting

c) 3D printers

Three-dimensional printing is one of the modern methods of manufacturing (manufacturing in addition) where a three-dimensional product can be manufactured stereoscopic and tangible by designing on a computer and then printed (manufacture) with a 3D printer. The printing process is done by stacking the material layers on top of each other until the desired object is completed the figures 3 Is the shape of the 3D printers.

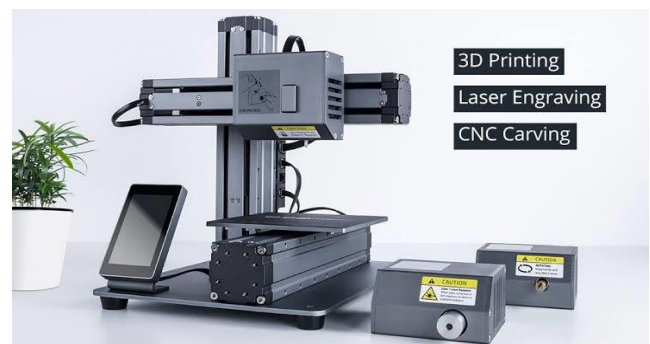


Figure 3: 3D Printing

d) Lathes Lath

One of the types of CNC machines that are used in the filling and manufacture of metals by rotating the artifacts to be formed, giving them the desired shape the figure 4 is the shape of the Lathes Lath.



Figure 4: Lathes Lath

e) Milling Machine

This type of CNC machine uses rotary cutters to cut different materials from manufactured materials. When she was working by hand the figures 5 Is the shape of the Milling Machine.



Figure 5: Milling Machines

f) Plasma Cutters

This type of CNC machine severs steel and other materials by plasma, and the cutting process is done using plasma scissors. hand the figures 5 Is the shape of the Plasma Cutters



Figure 6: Plasma Cutters

The advantages of CNC machines

The lifeblood of any producing country is industry. The more the industry relies on machinery, the more successful it is. The more accurate these machines are at work, the faster they are better if scientists start to develop the use of electronic systems in the field of mechanical machines. and worked to connect these machines to the computer for the increasing control. The CNC advantages:

- Programs can be entered directly from the machine and saving them in the memory of the computer attached to the machine
- Easy of correcting and reviewing the program.
- The input data is less and output production is faster.
- This safety machine of the operators.

- The Activity works are High because the system machine allows to the works to do other jobs at the same time.
- Produces high-precision products for all pieces due to the use of the same program.
- Producing complex products that are difficult to produce on traditional machine.
- Reduce the total production time because it needs to adjust and equip the machine only in the first operation.
- Reducing production cost. Because there is no waste in production
- Saving the consuming time in Production compared with the traditional machines.
- Provides high precision in the production of parts.
- the ability to repeat the large number of products with the same precision for all pieces
- Ability to control appropriate cutting conditions.
- Easy of movement between different forms of products.

Disadvantage of CNC machines

There is no perfect invention in the world when it has advantages, it is meaning has disadvantages but the good invention it's the advantages is bigger than its disadvantage.

The CNC disadvantages:

- The high cost of the machine.
- Operator must be provided at the highest level of training to deal with this type of machines.
- Shortage of specialists in the maintenance of this type of machines.
- Providing special Tools for remote control this machine and till working continually.

Stages of CNC work

The data is transferred the input and output because there is a computer and compares it inside of the memory or on the device and read the sensors and return to the computer to compare between the input and the sensor reads until we reach the lowest possible error rate and thus reach the highest accuracy and high quality stages of CNC work:

- 1) CAD
- 2) CAM
- 3) Machine control and operation Conclusion

Computer-Aided Design (CAD)

The computer design system has been closely associated with the development of the concept of computer graphics. However, the concept of computer design goes beyond many computer graphics in terms of analysis and modeling. However, interactive computer graphics (ICG: Interactive Computer Graphics) is the necessary technical basis for the computer design system. It is a software that allows us to draw the geometric pieces to be produced in all dimensions and then convert the two-dimensional shapes to three-dimensional if necessary. It also allows us to simulate geometric pieces in terms of movement, distribute stresses and also allows Draw the curves of forces and moment that affect the piece of engineering to be produced We then save the file in an appropriate format for understanding CAM software the most famous of these programs:

- Autodesk Inventor
- SolidWorks
- CATIA

The figure 7 it explains how to process cad software: The sketch is beginning from start and adjust settings. if we need draw the 2 dimensions, we choice the 2D icon or if we need draw 3 dimensions, we choice the 3D icon. and we can transfer design 2D to 3D by option in software. After finish the design we export the design to program languages for reading the design by CAM [7].

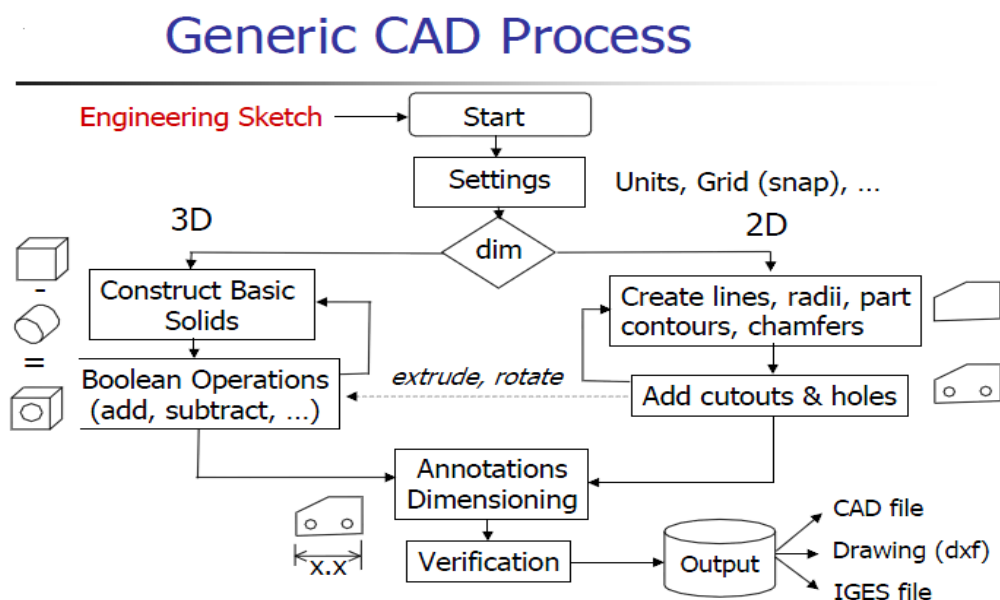


Figure 7: Generic CAD Process

Computer-Aided Manufacturing (CAM)

Computer Aided Manufacturing can be defined as the use of computer systems to plan, manage and control manufacturing processes through direct or indirect interaction of computers with production sites in the factory. CAM is a software that converts a part of engineering designed on CAD software to GCODE to enable the CNC machine to read the design. This GCODE is transferred to the CNC machine directly from the software via a network cable or indirectly via Flash memory and then determine the parameters of the CNC machine for the beginning of the manufacturing stage [8]. The most famous of these programs:

- Surfcam
- PowerMill
- Hsm
- Solidcam

The figure 8 it shows and summarized the typical workflow of a CAM system. The order of the definition can be different in different CAM systems, but the definition of the listed data is required every case for appropriate work. The most important application of the CAM systems is the milling technology, so hereafter I focus to this application [9].

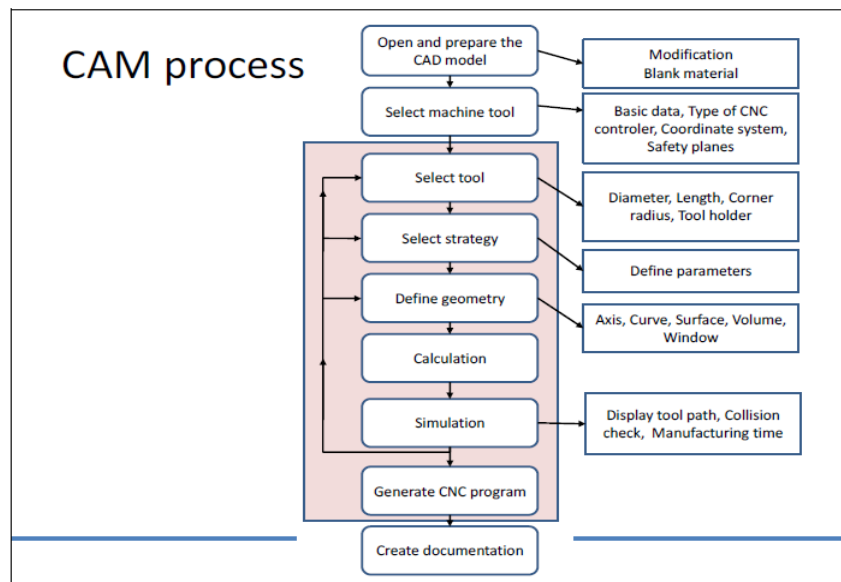


Figure 8: CAM Process

Machine control and operation

The CNC machine tool equipment performs operations by achieving linear sliding and rotating movements. These normal movements are designed by the machine manufacturer and can change from machine to machine. The system will respond to the axis moving command (cutting tool) along the X + or Y + axis of the table by moving it in the opposite direction -X, -Y because the machine automatically learns how to move in response to a move order on an axis. It does not need to know if the table or the axis of the machine is moving. The only important thing here is that the cutting tool axis or cutting tool reaches the location you want to reach according to the program. All control systems are used to prevent automation of the machine unless the return to zero is executed. This is a good safety feature. The zero is placed at the junction of the positive

ends of the axle movement areas. After the program is loaded into the MCU, the programmer works to enter other important information which is left blank by the programmer, the most important of which is to locate the reference point of the occupied or zero program Part Origin for the zero-machine home [10]. For CNC operation:

1. Ensure a suitable working environment.
2. Ensure suitable and safety feeding for machine.
3. Choose cutting tools with adjust its length to suit the machine.
4. Selecting the metal to be used.
5. Operation of the machine.
6. Download the piece program it will be produced. from the CAM program according to the language that suits the machine.
7. Copy the program to the machine memory.
8. Adjust zero widget.
9. Choose the appropriate parameters.
10. Run.
11. Control work.

CONCLUSIONS

In this article we explained about the computer numerical control (CNC). its history, what is its components. What is its mechanism of work and the benefits and disadvantages. we talked about the computer-aided design (CAD) and computer-aided manufacturing (CAM) and what its work in CNC. So we found whatever the disadvantage of computer numerical control (CNC), it is better than traditional machines that cannot produce a model, product or template with high accuracy and low cost with a small time that any error in the design model negatively affects the mold and this leads to weakness in the design of molds and hence the importance of computer numerical control (CNC), where it can avoid all defects in design and production In addition, the complex products we use in our daily lives can only be produced by computer numerical control (CNC).Workshop machines play an important role in the manufacture of most metal products, and workshop workers use them to make parts of some products, such as cars, molds, different production machines and refrigerators. Many other products are made by machines made by machines. Others, known as grinding or drilling, perform multiple tasks. Automated machining centers have devices. Automatic to change the kit, some may use more than a hundred kit. Workshop machines can connect to form a flexible manufacturing system. Each machine

performs a different operation of the product in the flexible manufacturing system. The product being filled, called the workpiece, is transferred from one machine to another by a robot and other automatic equipment. A single flexible manufacturing system can make various parts. The number of machines is available in a wide range of sizes,

REFERENCES

1. Emilio Bautista Paz Marco Ceccarelli Javier Echavarri Otero José Luis Munoz Sanz © Springer Science+Business Media B.V. 2010. A Brief Illustrated History of Machines and Mechanisms Springer, London New York Library of Congress Control Number: 2010926023
2. Vijjika Singh © The author(s) 2015. The Technologies & Machines That Powered the Industrial Revolution, Published with open access at www.questjournals.org
3. Julian Happian-Smith PhD, MSc, BTech, Cert Ed HE, MSAE © Reed Educational and Professional Publishing Ltd 2002, An Introduction to Modern Vehicle Design,
4. Syh-Shiuh Yeh & Zheng-Hong Tsai & Pau-Lo Hsu ©Springer-Verlag London Limited 2019, Applications of integrated motion controllers for precise CNC machines
5. Heinrich Arnold © November 2001, The recent history of the machine tool industry and the effects of technological change (University of Munich, Institute for Innovation Research and Technology Management November 2001)
6. Morched Dallali © May 2010 Concept of CNC Machine / Bachelor thesis /Centers SLOVAK UNIVERSITY OF TECHNOLOGY IN BRATISLAVA Faculty of Mechanical Engineering
7. Prof. Olivier de Weck ©January 6, 2005 Engineering Design and Rapid Prototyping Lecture 4
8. Mach motion Specializing in CNC Automation and Motion Control G & M Code Copyright © 2016, Mach Motion All rights reserved.
9. LÁSZLÓ KÁTAI, ÓU COPYRIGHT © 2012-2017 CAD Book,
10. Fundamentals of CNC Machining Copyright 2014 Autodesk, Inc.
11. Dr Atul Thakur Assistant Professor Department of Mechanical Engineering lecture Computer Numerical Control,
12. Introduction to Computer Numerically Controlled (CNC) Machines Version 2 EE IIT, Kharagpur