Module-V

What is Numerical Control (NC)?

Form of programmable automation in which the processing equipment (e.g., machine tool) is controlled by coded instructions using numbers, letters and symbols - Numbers form a set of instructions (or NC program) designed for a particular part.

Advantages of NC

NC systems aid in the automation, used to produce complex parts, greater accuracy, less production time, less labor cost.

Disadvantages of NC

utilize complicated and complex technology, necessitates a larger investment

Numerical control (n.c) procedure

a) Process Planning: - This is listing of the sequence of operation to be performed during manufacturing of a part. This as well lists the machine by which the part to be made is routed.

b) Part Programming:-The part programmer is responsible for planning the sequence by N.C system and to document these in a special format.

c) Tape Verification: - The tape is checked for its accuracy. It is checked by two methods. To run the tape through a computer program that will point out the contents of the tape and errors in the tape can thus be checked.

d) Production: - The corrected tape is then used for manufacturing the parts on the N.C machine. The operator loads the raw materials on the machine tool and adjusts the position of the cutting tool relative to workpiece. The N.C system then takes over and machines the part according to the instructions on the tape.

Basic Components of NC machine

The basic components are:
Program of instructions
Machine control unit in
Machine tool or Processing equipment or other controlled processes

What is the difference between CNC and NC?
the NC directly controls the machine tools using punched cards. In contrast, CNC uses computer systems.

The Features of CNC Machining

1.High adaptability. Using CNC machines to produce different components is always decided by different program. It doesn't need to produce and change too many tooling and clamp like general machine. So CNC machining is more used for small batch production, new products development, etc. It can help reducing the production time and costs.

2. High precision. The precision by CNC machining can reach to 0.005-0.01mm. The CNC machine is controlled by numeric signal. When the numeric equipment output a impulse signal,the machine moves workpiece moving a pulse equivalent(about 0.001mm). And the error between the reverse clearance of machine feed drive system and thread pitch can compensate by the numeric equipment. So the CNC machining have high precision.

3.The quality of CNC machining is stabilization and reliable. Using the same CNC machine with the same tooling and program to produce a batch of components, the cutting path is absolutely the same for each workpiece. So the production components is all the same.

4. High productivity.

5.Improving working condition. After adjustment of CNC machine,input the program and then start the machine,the machine can produce workpiece automatically and continuously. The operator just need to input the program, edit, clamp and remove the workpiece,preparing tooling, watching the processing and inspecting the workpiece.

Additive manufacturing:

Additive manufacturing is the process of creating an object by building it one layer at a time. It is the opposite of subtractive manufacturing, in which an object is created by cutting away at a solid block of material until the final product is complete.

Fused deposition modeling

Fused Deposition Modeling (FDM) or Fused Filament Fabrication (FFF), is one of the most common methods of 3D printing. FDM printers extrude a thermoplastic filament in a series of layers over a build plate to create a three-dimensional object. Objects created by FDM begin as computer-aided design (CAD) files that have been converted to a format that a 3D printer can translate. Once an object is printed using fused deposition modeling, the support material is removed.

FDM is an inexpensive process, works well with a wide variety of plastics and can incorporate carbon fiber and other composites. However, the parts produced may be anisotropic, meaning they have uneven strength in some directions, which can limit their industrial use to prototypes and low-strength tools and fixtures.

Material jetting

Material jetting is the additive manufacturing technique in which droplets of thermoplastic are selectively deposited using drop on demand (DOD) technology.

In material jetting, the print head is not heated to bind the material. Instead, an ultraviolet (UV) light source is used to cure the liquid resin.

The print head deposits a layer of liquid photopolymer resin on the print bed. A UV source moves over the deposited layer, polymerizing the build material. The build platform then moves down by the thickness of one layer, and another layer of material is added over the previous layer. This process repeats until the entire 3D object is finished

Binder Jetting

Binder jetting, also known as drop-on-power printing, is a 3D printing process that creates solid objects using a 3D CAD file. It works with a variety of materials, including ceramics, composites, sand, and plastics.

In binder jetting, the process uses a modified version of the inkjet printing process, therefore not requiring a heat source to bind the materials.

Building material is applied to the print bed. Next, the print head selectively binds the build material according to the part's 3D CAD data. The build platform is then lowered by the thickness of a single layer. This process is repeated, connecting the layers of powder into a finished part.

Sheet Lamination

Sheet lamination, also called laminated object manufacturing (LOM), is a rapid prototyping process in which sheets of material are joined together to create an object.

It is commonly used for building durable 3D objects with complex geometries.

A roll of build material, such as paper, is introduced on the build surface. Next, a bonding adhesive is applied to the build material and a heated roller moves over the surface of the material, thus binding the material. A computer-guided laser beam or knife is then used to cut the sheet according to 3D CAD data, removing excess material. The next layer of the material is positioned on the print bed and this process is repeated until the part is complete.

Robots in the Manufacturing: Types and Applications

Articulated Robots

Articulated robots are among the most versatile and widely used types of industrial robots in manufacturing. These robots feature multiple joints, or axes of rotation, which allow them to move in a highly flexible manner. The most common configuration of articulated robots is the 6-axis robot.

SCARA Robots

SCARA, an acronym for Selective Compliance Assembly Robot Arm, is a type of robot specifically designed for high-speed assembly and material handling applications. SCARA robots are known for their speed, precision, and ability to perform tasks within a limited workspace, making them an excellent choice for industries such as electronics, automotive, and consumer goods manufacturing.

Delta Robots

Delta robots are a type of parallel robot known for their speed, precision, and lightweight design. They are particularly suited for high-speed pick-and-place applications, where rapid movement and accurate positioning are critical. Industries that commonly use delta robots include food and beverage, pharmaceutical, and electronics manufacturing.

Cartesian Robots

Cartesian robots, also known as linear robots, are a type of robot that operates within a three-dimensional Cartesian coordinate system. This design provides a straightforward and easily understood framework for robot movement, making cartesian robots ideal for a wide range of manufacturing applications, including assembly, material handling, and machining.