

# Research on Programming Technology of NC Machining Based on Hydraulic Drive

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**Keywords:** Hydraulic drive; Mechanical numerical control; Processing; Programming technology

**Abstract:** In order to ensure the machining quality of the machined surface, when machining mechanical parts, concave shapes are sometimes finely machined. In general, the processing tool is ball end mill. The G code of numerical control lathe is difficult to realize ellipse machining, but it is realized by parameter programming. The program of parameter programming is greatly simplified, and the application range of numerical control lathe can be expanded. At present, the commonly used programming technology of electronic and mechanical numerical control machining mainly includes machining of mechanical numerical control parts and CAXA manufacturing engineering. During cyclic processing, the tool lifting point and the tool setting point may be separated. Therefore, on the premise of ensuring safe production, the tool lifting point should be close to the work piece to save the execution time as much as possible. This paper mainly discusses the programming technology of NC machining based on hydraulic drive.

## 1. Introduction

The basic principle of hydraulic drive technology is to use pressure oil as working medium to complete the process of energy conversion and power transmission in a closed container, which is the basic principle of hydraulic drive technology [1]. At the present stage, through the unremitting efforts of scientific researchers, people have turned numerical control processing into technology and advanced information technology for good integration, and applied it to the production and manufacture of mechanical parts in our country. Traditional machine tools have their own advantages in some aspects. On the basis of maintaining the advantages, combining informatization and intelligence is a major development trend of the equipment industry [2]. Among them, the application of programming technology of numerical control machining technology can not only properly optimize the machining process of mechanical parts, but also help people to carry out corresponding research and analysis on relevant process information of cutting tools and equipment. The machine tool has an adaptive control function, which automatically adjusts the position and speed of the cutter and the work piece by detecting cutting force, spindle stroke speed, acceleration and other information of gear shaping. At present, the commonly used programming technology of electronic and mechanical numerical control machining mainly includes machining of mechanical numerical control parts and CAXA manufacturing engineering [3]. As the programming technology of NC machining involves many aspects, scientific design and comprehensive consideration should be carried out in combination with specific requirements and specifications. This paper mainly discusses the programming technology of NC machining based on hydraulic drive.

## 2. Overview of Hydraulic Drive Technology

The hydraulic drive system consists of five parts: power unit, actuator, control unit, auxiliary unit and working medium. The external position closed loop uses grating ruler as detection element to directly obtain displacement information, and the inner loop angle follow-up system drives the motor [4]. It is suitable for single piece and small batch production, and can also be used for mass production. The machine tool mainly processes inner and outer straight cylindrical gears, straight non-cylindrical gears of various shapes and flat cams. At the same time, in the process of adjusting the machine tool, the cutting tools should be placed as close to the work piece as possible, so that

the cutting tools can be installed in a scattered and orderly manner and will not interfere with each other due to too close a distance. Because the phenomenon of "empty knife" will cause unnecessary waste and consumption of energy, moreover, when changing knives, the feeding route should also pay attention to the work piece being encountered when changing knives. Among them, the control device is composed of control valves, pressure control valves, flow control valves and other control valves. It is necessary to use a tool with a smaller radius to process the profile of mechanical parts. The system uses standard numerical control instructions, can directly draw the rotor end surface curve, the system can automatically generate the tool path trajectory, and can be processed after post-processing [5]. The cutter structure is in the form of double cams, and the main drive adopts a new structure to ensure long stroke length and large cutting force of the cutter spindle, and can be automatically adjusted to any position within the stroke length range for cutting.

### **3. The Value of Programming Technology for NC Machining**

#### **3.1. Change traditional ideas**

Two-dimensional numerical control machining is a basic numerical control machining method, which can be used to machine planar contour, planar cavity and two-dimensional half cavity and other types of parts. The system can realize the automatic operation and manual adjustment of the manipulator, and at the same time ensure the quick and stable operation of the whole machine. This is to avoid major problems in parts processing, which will further affect the use and cost. In the traditional mechanical numerical control machining, our country mainly relies on manual operation of machining technology. When programming, it is necessary to specify the location of each type of tool in each machining program, including the spatial location of tool replacement. During cyclic processing, the tool lifting point and the tool setting point may be separated. Therefore, on the premise of ensuring safe production, the tool lifting point should be close to the work piece to save the execution time as much as possible. Under normal circumstances, a fillet milling cutter will be selected, which can ensure even finish machining allowance, thus improving contact flexibility and machining efficiency.

#### **3.2. Realize intelligent processing**

In order to ensure the machining quality of the machined surface, when machining mechanical parts, concave shapes are sometimes finely machined. In general, the processing tool is ball end mill. Until the effective equidistant rings cannot be generated, connecting these disconnected equidistant rings in a certain way will generate the tool center trajectory in the ring cutting process. According to different types of cutting tools, combined with application effect requirements, the cutting tools with smaller radius are preferred for processing. Especially in the corner processing. After the detailed definition of the process plan is completed, a large number of complicated operations will be completed accurately and reliably by the computer. The control system is equipped with safety interlock protection, cutting parameters and operation interface protection, etc. In case of machine tool failure or misoperation, it can automatically stop or cannot be started. The fillet milling cutter has the advantage of being able to cut within 90 degrees of contact between the machined parts and the cutting edge, and being able to maintain the continuity of production and processing of mechanical parts [6].

#### **3.3. The added value of the product is increased**

Because the machining cavity is very complex, in order to complete the machining of mechanical parts, it is necessary to change different tools frequently in the machining of numerical control milling. The application of programming technology in the field of China's mechanical numerical control processing can improve the quality of China's numerical control processing products, and solve the energy consumption and pollution emission in the processing process. The G code of numerical control lathe is difficult to realize ellipse machining, but it is realized by parameter programming. The program of parameter programming is greatly simplified, and the

application range of numerical control lathe can be expanded. If the process is not up to standard or there are problems, it will directly affect the quality and processing cost of processed parts. In the specific processing operations, CAM software is mainly used to control terminal control [7]. Therefore, the relevant technical personnel must be careful in choosing the cutting-in and cutting-out methods of the cutter. In the actual industrial production process, hydraulic drive technology can be used to accurately divide the positions of major systems, so that the power unit, control and adjustment device, execution device and other systems can be better adapted to the requirements of automatic production at appropriate positions.

## **4. Programming Skills of NC Machine Tools**

### **4.1. Scientific choice of feeding route**

At present, most of the machining of mechanical parts are "complex shapes", and the symmetry and structural composition of parts need to be closely matched without any gap [8]. Only by scientifically selecting the feeding path can the coding reasonably reflect the mechanical manufacturing process. The control of hand clamping and releasing action is driven by the combination of double-acting piston cylinder with cam and connecting rod mechanism. For example, the precision of traditional numerical control processing equipment is not high, which will reduce the efficiency of numerical control processing technology. Therefore, in the future development, it can be replaced by medium water with simple structure and high efficiency. The model of the mechanical part can be roughly machined by finishing the side wall of the mechanical two-piece cavity and cutting in from the outside of the mechanical part. However, if people have clear requirements on the processing quality of convex surfaces, we must use round-corner end mills to process them. In a limited period of time, all efforts can be focused on defining the processing technology arrangement of complex profiles, which is extremely beneficial to improving the processing technology planning quality of complex profiles.

### **4.2. Reasonable choice of program origin**

When programming a numerical control machine tool, it is necessary to first select an origin to establish a coordinate system, and the selection of this point is crucial to the alignment of the work piece. Generally speaking, the intersection point between the axis of the work piece and the front and rear end faces is the origin of the program. After the datum point is located, it is necessary to compare the position of the cutter point on the machine tool. Can carry on the comprehensive scientific analysis to the related prop equipment and so on, then finds out the existence flaw and the insufficiency. In the application process of mechanical numerical control machining programming technology, the effective integration of numerical control technology, information technology and mechanical machining technology can improve the control efficiency of machine tools and equipment in the mechanical production process. In the process of specific operation and application, only the NC machining process plan of complex profile needs to be clearly expressed in CAM language and the machining coordinate system needs to be clearly defined [9]. According to the conditions of gear modulus, tooth number and the like, it is necessary to select and match the split gear and the circumferential feed gear. Cutting depth shall be adjusted step by step during gear shaping. However, it should be noted that in the process of machining the convex surface of mechanical parts, flat end milling cutter is usually selected as the main machining tool. It can further exert its own advantages in terms of displacement, differential, commutation, etc.

### **4.3. Reasonable choice of tool type, pay attention to the programming and design of tool withdrawal route**

Generally speaking, the algorithms involved in 2D NC programming include: equidistant loops, set operations of loops, intersection operations of geometric line segments, straight line approximation of spline curves, and connection of tool paths. However, due to the different materials, the cutting effects of different cutters are different, and the programming feed route

naturally needs to be adjusted randomly. Therefore, it is necessary to strengthen the selection of cutting methods for cutting tools. During rough machining, the geometry of the allowance left after each machining is not the same. The use of hydraulic drive technology can further reduce the difficulty of accurately controlling motion and dynamic parameters, ensure the accuracy of parameters, and at the same time can highlight its own low speed load characteristics [10]. If the processed mold material is soft, the spiral line is usually selected or cut in a diagonal line. If the cut-in method is not selected properly during the next cut-in, it is easy to cause a cut-in accident. In order to minimize the frequency of risk failures, it is necessary to exchange different cutter types. When determining the direction of the processing coordinate axis, the clamping and placement of the processed products on the numerical control machine tool should be considered.

## 5. Application of NC Machining Programming Technology in Mechanical Manufacturing

### 5.1. It is applied to parts processing

The straight line approximation method is a processing method for approximating ellipses with multiple straight lines, and is usually applied to high-precision processing of non-circular curves such as parabolas and hyperbolas. Using numerical control machine to process ellipse, parameter programming can effectively control the processing execution and ensure the expected effect of process production. Number of each tool type has a different effect, so according to the design principles and technological processing requirements first choose a reasonable tool. Each action is required to be executed strictly in sequence, so step-by-step instructions are adopted to ensure that the manipulator runs in an orderly manner and will not cause chaos even if misoperation occurs. When finishing mechanical parts, a tool with a smaller radius should be used, especially for corner machining. Attention should be paid to the influence of surface accuracy when cutting in and cutting out the tool in the use of programming technology. Therefore, the most reasonable and suitable cutting-in and cutting-out methods should be used to design when setting the amount of program. For example, the research of surface materials can improve the corrosion resistance of hydraulic drive system and reduce the size of equipment.

The tool path is the trajectory and direction of the tool position relative to the work piece in NC machining. Surface roughness is an important requirement to ensure the surface micro-precision of parts, and is also the basis for reasonable selection of numerical control lathes, tools and determination of cutting parameters. Cutting mode and feeding mode have a deep influence on the production efficiency and quality of mechanical parts. It is mainly applied to finish machining the side wall of the mechanical two-piece cavity and cutting in from the outside of the mechanical part to roughly machine the model of the mechanical part. The ellipse is approximated by a small straight line segment, and the error in process production is relatively small and the precision is relatively high. The system is started, the manipulator is in the waiting state, and the manipulator starts to operate after obtaining the material taking signal. Then a group of parallel straight lines and equidistant rings are used for intersection calculation, and the intersection line segments obtained by intersection are processed and connected to generate the tool center track in line cutting processing.

### 5.2. Application in CAXA manufacturing engineering

With the continuous development and improvement of CAD/CAM technology, they have been widely used in various fields. Its CAD module can realize feature-based solid modeling function. The application process flow of CAD/CAM in complex profile processing is shown in Figure 1.

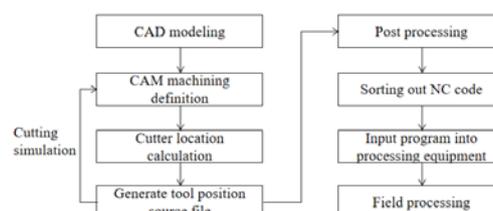


Figure 1 CAD/CAM application flow chart

According to AM/CAD software of solid and curved surface, the appropriate programming software and program are selected. The software can effectively ensure flexible adjustment of processing trajectory parameters, thus realizing its due functions and functions. In the actual CAXA project process, the mechanical numerical control processing programming technology can realize the high efficiency control and the quality code number widespread application. As long as the polar coordinate equation is fully utilized, the existing programming content can be well popularized and introduced. For example, in this part, the values of ellipse minor half shaft and major half shaft change, so long as the values of A and B are changed. Carry out corresponding scientific design program for NC machining program; It is necessary to set the processing method and specific processing parameters in advance. Due to its simple structure, it can be programmed manually and is not considered in the process planning of complex mould surface. So as to carry out overall dynamic supervision on the integral five-axis linkage technical equipment. While ensuring the stable performance of the five-axis linkage production benefits, it can also reduce the loss of machinery operating funds and improve the operating benefits of the machinery manufacturing industry.

## 6. Conclusion

To sum up, in the process of our country's development, our country's NC machining programming technology has great application advantages in machining and manufacturing. The process route optimization design should follow the principles of reasonable selection of machine tools, centralized procedures, convenient programming, reasonable selection of clamping methods, rough first and fine second. For NC machining and programming technology, specific analysis is required for specific situations. After comprehensive analysis and calculation, dynamic parameter adjustment is carried out in combination with actual conditions during machining and use. The numerical control machining programming technology is applied to the development of a multi-axis synchronous control machine tool numerical control system based on hydraulic driving main motion, so as to realize the efficient machining of the machine tool with complex shape and hydraulic driving main motion. In the next few years, the demand for mechanical processing will also increase. With the gradual introduction of high-precision technology into production, the demand and standards for the production of numerical control machine tools will also increase accordingly. Therefore, the innovation and development of this technology will continue.

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