

Research on the Status Quo and Development Trend of Numerical Control Technology

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Abstract. CNC technology has brought about changes in the traditional machinery manufacturing industry. The establishment of the CNC production line announced the era of formal industrialization of manufacturing. With the continuous maturity and development of numerical control technology, the mechanical automation industry has played an increasingly important role in the national economy and the people's livelihood. This paper explores the current situation and future development trend of numerical control technology.

Introduction

Numerical control technology is a technology that uses digital information to control mechanical movement and working process. [1] It is a modern manufacturing industry integrating traditional mechanical manufacturing technology, computer technology, modern control technology, sensing detection technology, network communication technology and optical electromechanical technology. The basic technology, with high precision, high efficiency, flexible automation and other characteristics, plays a decisive role in the flexible automation, integration and intelligence of the manufacturing industry.[2] CNC equipment is a mechatronics product formed by the penetration of new technologies represented by numerical control technology into traditional manufacturing industries and emerging manufacturing industries. CNC technology is the basis of manufacturing automation, the soul of modern manufacturing equipment, an important means of modernizing the national industry and national defense industry, and is related to the national strategic position, reflecting the level of national comprehensive national strength, the level of its level and the amount of CNC equipment possessed. [3-6] It is an important indicator of the industrial modernization of a country.

Development History of Numerical Control Technology

In 1948, the US Air Force commissioned Parsons to develop equipment for machining aircraft propeller blade profiles. However, the shape of the template is complicated and the precision is very high, and the ordinary processing equipment cannot realize the operation, so the idea of computer-controlled machine tool is formed. Parsons and the Massachusetts Institute of Technology began research on CNC machine tools in 1949. The first three-axis CNC milling machine was successfully trial-produced in 1952, when the original CNC tube was used. The use of 1957 marked the official start of the CNC machining era.

In 1959, the numerical control device began to use a hardware circuit system based on transistor circuits. This CNC machine tool is more sensitive and can automatically change the tool. It is called a machining center. Since then, CNC devices have entered the second generation.

In 1965, the third-generation integrated circuit numerical control devices with small size, low power consumption, and improved reliability were introduced. The continuous decline in prices has promoted the development of different types of CNC machine tools and their output. The first three generations are the first stage of the development of numerical control technology, which is mainly composed of hardware linkage structure, so it is also called hardware numerical control phase.

In 1970, the DNC system and the CNC system appeared, and the fourth generation led by small computers began.

In 1974, a microcomputer-controlled numerical control system (MNC) was developed, which used a microprocessor and a semiconductor memory to start the fifth generation led by a microcomputer.

In 1990, the sixth generation of a general-purpose CNC system using an industrial PC was introduced. This latest sixth-generation system is based on the hardware of the PC as the control system, and the NC software system is also installed on the PC. The latest generation of systems is easy to maintain and puts networked manufacturing into practice. The last three generations are the second phase of the development of numerical control technology, mainly by software, so it is also called the software numerical control stage.

Development Status of China's Numerical Control Technology

After the start of the late 1950s, after experiencing the development of various stages, China has basically mastered the numerical control technology. On this basis, it has established a base for CNC development and production, and cultivates talents. Under these conditions, we have initially formed our own CNC industry.

In recent years, with the rapid development of China's economy, the demand for equipment has become higher and higher, which has brought high technical requirements to the domestic machinery manufacturing industry. In terms of improving production efficiency, numerical control technology has become a key part. Although China now has more than 100 CNC machine tool manufacturers, there are thousands of products produced, but the proportion of machine tools in the world is still very low, less than 5%. Compared with developed countries, China's numerical control technology has many shortcomings, mainly in the following points.

First, copying and copying, the degree of innovation is low. China's numerical control technology is still imitating foreign CNC market, copying and copying existing foreign products, what others do, what we do, over-reliance on foreign technology, and no innovative ingredients. We have not applied the technology to accelerate the development of China's numerical control technology. We have not fully and thoroughly digested it, but only stayed on mastering existing technologies and increasing localization rate. In this way, our dependence on foreign CNC technology will become stronger and stronger, and we will not be able to get rid of it.

Domestic CNC technology companies have a weak sense of technological innovation. The lack of strong pursuit of economic interests and the unfamiliar pressure of external market competition make enterprises have little incentive for technological innovation and cannot form a competitive environment conducive to technological innovation of Chinese enterprises. A good technological innovation mechanism is also indispensable for an excellent enterprise. However, most of the enterprise technology innovation organizations in China have not established such a mechanism, and the overall view is still a loose sand. To achieve a high level of scientific research results, it still seems impossible to achieve.

Third, product reliability is not high. Mean Time between Failure (MTBF) is generally used to determine product reliability. The MTBF of foreign CNC systems is above 10 000h, while the MTBF of domestic CNC systems is only 30%~60% of foreign CNC systems, which will greatly affect the market share of products.

In addition, China still has problems such as low degree of network and relatively occluded system structure, which has led to a large gap between China's numerical control technology and the international. We should find ways to connect with the international community and narrow this gap.

The Development Countermeasures of Numerical Control Technology

The rapid development of social science and technology has promoted the development of CNC technology to a more scientific and modern development direction, and constantly improved the numerical control processing equipment to make it more perfect and standardized. It is the basic condition for the realization of scientific and technological development of numerical control

technology. In order to improve and develop CNC technology in essence, it is necessary to improve the CNC machine tools, simulation systems and servo drive systems in an all-round way to adapt to the continuous development of CNC technology, and further promote the open and intelligent CNC technology. , networked, integrated development path.

The rapid development of modern social economy and the accelerating modernization process have led to the rapid development of the machine tool industry. Based on this background, the transformation of CNC machine tools came into being. Due to the short time and low cost of transforming the machine tool, the numerical control machine tool is widely used in transformation. The machine tool is modified to diagnose and repair the machine tool fault, restore the machine tool function process, and renovate the machine tool appearance. The mechanical parts can be reworked, which greatly enhances the efficiency and automation of the machine. At the same time, advanced CNC systems can be updated on ordinary machine tools to transform this ordinary machine tool into an NC machine tool. In addition, if you want to make a technical breakthrough in the grade and performance of CNC machine tools, you can also transform it.

Physical simulation and geometric simulation are the basic technical guarantees for virtual manufacturing. At this stage, geometric simulation has a relatively mature software system. Physical simulation is difficult to model, and the cutting mechanism is complex, and its research still needs further development. In virtual manufacturing, the study of the cutting process is of great significance. Foreign countries have research on cutting formation, surface quality, cutting force, etc., and there are also researches on physical simulation processing quality in China, which will play a positive role in the future development of CNC systems.

Opportunistic drive technology is one of the important factors for industrial intelligentization and intelligent control in CNC machine tools. The development of opportunistic drive technology is based on the development of power electronics technology, network technology and microprocessor technology. Therefore, servo drive technology has become one of the core technologies in CNC machine tools, and has attracted widespread attention. The use of servo drive technology will also become an important mobilizer for the intelligent development of CNC technology.

The New Development of CNC Technology

In recent years, high-speed CNC machining has gradually become a hot topic in international manufacturing, and speed and precision are important technical indicators of CNC systems. As a key to affecting product quality and production efficiency, more and more attention has been given. Promoting the development of high-speed and high-precision CNC technology has become the basis for the future development of the CNC industry. According to the latest survey, the spindle speed of foreign high-end CNC machine tools is up to 100000r/min, the fast-forward speed is up to 120m/min, and the 5-axis linkage is gradually realized, which greatly improves the manufacturing process efficiency. In the future development of numerical control technology, in order to improve the machining accuracy more effectively, the following measures can be used to control, for example, to increase the minimum resolution of the system to 0.02 μm or higher; to convert the traditional servo system into a full digital AC servo. Shorten the interpolation period; use advanced and precise control algorithms to enhance the accuracy of the servo system and strive to achieve zero error tracking. By promoting the development of numerical control technology in the direction of high speed and high precision, China's manufacturing industry will gradually step into the development trend of high productivity.

PC is the largest computer product in the world today. Its data processing capability is powerful and its speed is fast. PC technology can be used to realize network communication and achieve a graphical interface. In addition, PC update is more frequent, and it is almost synchronous with the development of the computer, which is conducive to function expansion or secondary development. Although the system structure of PC embedded NC has a certain degree of openness, due to the traditionality of the system, it is difficult for users to enter the internal core of the CNC system, and its complicated mechanism and expensive price make it difficult to be widely used. The NC embedded PC is a relatively independent system, which can be used alone, and has superior PLC

control capability, low cost, high reliability, convenient networking and rich software resources, so it is widely used. Fourth, the future development trend of CNC technology

With the development of numerical control technology, its application field is no longer limited to the traditional manufacturing industry. In some important industries, such as automobiles, light industry, medical care, etc., it has also integrated into modern CNC technology, and for these industries. Development has played a significant role in promoting. Nowadays, the mainstream development direction of numerical control technology is mainly as follows:

The open development of CNC technology can effectively make the CNC system more flexible, flexible, adaptable, versatile and expandable, promote the development of network and intelligent, and enable CNC equipment and CNC machine tools to be updated according to the development of the times. . The open CNC system can operate effectively on different platforms, interact with other systems, and interact with users. Therefore, open systems are characterized by interoperability, interchangeability, and scalability. The open structure can be automatically programmed by voice control using general-purpose microcomputer technology to realize automatic scanning of graphics scanning. The reliability of the system is greatly improved, and the numerical control system is further miniaturized and miniaturized. At the same time, the use of its open and soft software and hardware resources can promote the numerical control system to achieve multiple varieties and multiple grades, and greatly shorten the production cycle.

With the rapid development of computer technology, artificial intelligence technology has penetrated into it, and the development of numerical control technology towards intelligence has become inevitable. The intelligentization of numerical control technology is to comprehensively monitor the manufacturing process by means of artificial intelligence technology, and to control the work process and decision-making. It realizes the intelligentization of CNC degree preparation, machining process and fault diagnosis. The intelligent numerical control technology mainly manifests in the following aspects: First, the adaptive control is integrated into the numerical control system, and various parameters are automatically measured, thereby achieving the maximum improvement of productivity and reducing production cost on the basis of ensuring product quality; Second, the automatic programming and man-machine dialogue functions are added; thirdly, the automatic fault diagnosis function is set; fourthly, the pattern recognition technology is used to enable the machine to automatically recognize the pattern and use its voice control technology to process the language command. Under the rapid development of computer technology, the intelligent numerical control technology will be more systematic and perfect, and the intelligentization of numerical control technology will also have a broader application prospect.

Networked numerical control technology is a new highlight of the international CNC machine tool expo in recent years. It is a powerful means for CNC technology to move towards a networked development pattern. Networked CNC technology can connect various machine tools, and then realize unmanned control and remote operation for networked machine tools. Control, effectively meet the information integration requirements of manufacturing companies and product lines, and at the same time update the manufacturing model, for example, the basic unit of virtual enterprise, global manufacturing, and agile manufacturing. The development of CNC technology network is convenient for communication between CN internal and digital servo and superior host computer, which facilitates the transmission of maintenance data, facilitates data exchange with other factories, and realizes wide sharing of information. In addition, the manufacturing industry can use the Internet to connect manufacturing companies with different locations and different manufacturing resources, to get rid of the time and space constraints in product design and processing, save time and improve production efficiency.

At present, the communication signal is modulated into a broad spectrum similar to noise by means of a cable-free wideband communication method for data and information transmission. This communication method replaces the traditional old communication method by means of the cableless connection, and reduces the number of cables in the NC system, and the security performance is extremely strong.

Conclusion

CNC technology is the technical guarantee for the progressive development of the manufacturing industry, affecting the development and prosperity of society and even the country. In the new wave of CNC technology innovation, we should clearly understand the situation, accurately grasp the development status and future development trend of CNC technology, adopt correct technological innovation methods, continue to innovate, keep pace with the times, and strive for continuous innovation in key technologies. Breakthrough progress has been made to promote the leap-forward development of China's numerical control technology and to catch up with the world as soon as possible, so that China can become a "manufacturing power" in the true sense.

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