

PAPER • OPEN ACCESS

## Research on Intelligent Technology of CNC Machine Tool Industrial Design

To cite this article: Qian Guiming 2021 *J. Phys.: Conf. Ser.* **1754** 012174

View the [article online](#) for updates and enhancements.

### You may also like

- [Binocular vision-based 3D method for detecting high dynamic and wide-range contouring errors of CNC machine tools](#)  
Xiao Li, Wei Liu, Yi Pan et al.
- [Optimised LightGBM-based health condition evaluation method for the functional components in CNC machine tools under strong noise background](#)  
Li Jia, He Jialong, Shen Wanghao et al.
- [Development of real-time prediction module for precision and error of CNC system finishing](#)  
Liang Lei, Ning Zhang and Peng Cai



**DISCOVER**  
how sustainability  
intersects with  
electrochemistry & solid  
state science research

# Research on Intelligent Technology of CNC Machine Tool Industrial Design

**Qian Guiming**

Sichuan Vocational and Technical College, zip code: 629000

**Abstract:** The level of economic development of a country can be demonstrated by the development of the machinery manufacturing industry. At present, the industrial design of CNC machine tool in China is progressing in the direction of intelligence, providing more efficient processing technology to meet the needs of the times and social development. However, there are still many challenges, which are the key research of the current intelligent industrial design technology. The article will analyze the significance of industrial design intelligence technology to CNC machine tool, analyze the current research status and propose the application strategies.

## 1. Introduction

As one of the important machinery manufacturing equipment in China, CNC machine tool is a way of using digital control technology to control machine tools. This requires computer technology and CNC technology as the foundation. Therefore, CNC technology is also called computer numerical control technology. CNC machine tools are used in modern industries such as transportation, electronics, mining, and military. With the rapid development of transportation, the demand for CNC machine tools in the automobile and mold markets is increasing, which brings new ideas to the development of the CNC machine tool industry. Opportunities and challenges require continuous innovation to meet the individual needs of users.

## 2. Significance of intelligent technology of industrial design to CNC machine tool

Intelligent industrial design promotes the development and transformation of CNC machine tool in China. As a large country in the production and use, some machine tool manufacturers only pay attention to the structure, but ignore the beauty and memory. With the continuous development national economy, people have a new level of spiritual pursuit. The use of machine tools is not only limited to the physical properties of the machine tool, but also the beauty, shape, and operability of the machine tool. More and more attention is paid to the spiritual enjoyment brought by machine tool. In the process of industrial intelligent production of CNC machine tool, designers should fully recognize the importance of industrial design intelligent technology to CNC machine tool, change the traditional concept, and transform to a humanized design that balances functions and forms [1].

The current domestic and foreign CNC machine tool market competition is increasingly fierce. If it only relies on the traditional production technology, due to the low level of production, structure and performance will not be coordinated. Lack of innovation ability and humanization and other reasons will lead to China be disadvantaged in the international market. Intelligent industrial design technology can ensure that China's CNC machine tools have high quality and low cost. At the same time, it will give full play to the maximum value of industrial design, improve the innovative ability, meet the user's personalized demand, improve user satisfaction, and improve the international



competitiveness of China's CNC machine tools. The intelligent technology of industrial design is being paid more and more attention and used by more and more CNC machine tool manufacturers.

### **3. Current research status of intelligent industrial design of CNC machine tool**

As the most important equipment in machinery manufacturing industry, the development of CNC machine tool is closely related to the productivity. China's domestic CNC machine tool from the original can not be independently manufactured. Nowadays, it can be independent design of CNC machine tools. China's CNC machine tools have gradually developed into a mature period of rapid development. China's market has been able to provide more than one thousand kinds of CNC machine tools for the vast number of manufacturers. The types of machine tools have also been improved to a greater extent. The gap between China's machine tools and the world's cutting-edge industry international is gradually narrowing. In some types of CNC machine tools manufacturing, China has walked in the forefront of the world.

Current worldwide numerical control machine tool manufacturing industry is relatively developed, including Asia, America and the European Union. China, Japan and Germany are the main producing countries with the absolute advantage. The scale of NC machine tool industry in China in 2019 accounted for 31.5% of the world, only less than 0.6% in Japan. With the current vigorous development of big data and cloud computing, it also provides new opportunities for the construction of CNC machine tool. If the current automatic control intelligent technology and traditional manufacturing technology are effectively integrated, the construction will have higher efficiency, easier operation and lower difficulty with a supporting operating system. The CNC machine tool technology can be developed to a greater extent. In the composition of the product structure of CNC machine tools in 2019, CNC special machining machine tools accounted for 16.8%, CNC metal forming machine tools accounted for 28.5%, CNC metal cutting machine tools accounted for 53.2%, and the output of machining center machine tools reached 60,900 units. It is developing in the direction of high-precision, high-speed, and five-axis linkage. The numerical control rate of machine tool output reached 41.09% in 2019, showing a spiral upward state. The intelligent development of machine tool is the general trend [2].

### **4. Application strategies of industrial design intelligent technology in CNC machine tool**

#### *4.1 Change the traditional application mode and strengthen the innovation and upgrade*

China's manufacturing industry has always been in a leading position in the world, and the role of CNC machine tool in the entire manufacturing industry is self-evident. Machine tool output is increasing year by year (figure 1). However, the current development is very uneven, and there is still much room for improvement in the innovation of advanced machine tools. For the innovative development of machine tools, R&D personnel are concentrated in colleges and universities and major research institutes across the country. Since companies are mainly for profit, they can't independently innovate to make their products more intelligent. In order to meet the needs of the development of the times, it is necessary to change the production mode, and master the basic technical knowledge of machine tool control.

For example, when technical personnel carry out innovative designs on machine tool, they should first integrate resources accordingly. For the hardware and software technology that the enterprise has, the machine tool design and technical personnel must master all aspects. In addition, technical personnel also update the software application model based on the actual situation and adopt the software application model provided by application services. Manufacturers of CNC machine tool usually have specificity, which will gradually improve their hardware development capabilities. However, their software development capabilities cannot follow the pace of hardware development very well. Enterprises can use the software application mode provided by application services to improve the hardware development capabilities. Enterprise software is managed uniformly. CNC machine tool manufacturing can only develop the hardware, and the software can be handed over to

the supplier, so that it can perform routine maintenance and management.

If an enterprise wants to set up its own software department, the research and development costs will be obviously huge. When the hardware and software application mode is upgraded, the enterprise can also cooperate with suppliers to establish a corresponding website on the Internet to promote its own strategy. It can provide better machine tool design solutions for manufacturing enterprises with the same attributes. At the same time, the enterprise can also select the competent hardware technology research and personnel, set up a special cooperation group to guide the relevant enterprises, so that the enterprise can improve their own intelligent system to obtain more economic benefits [3].

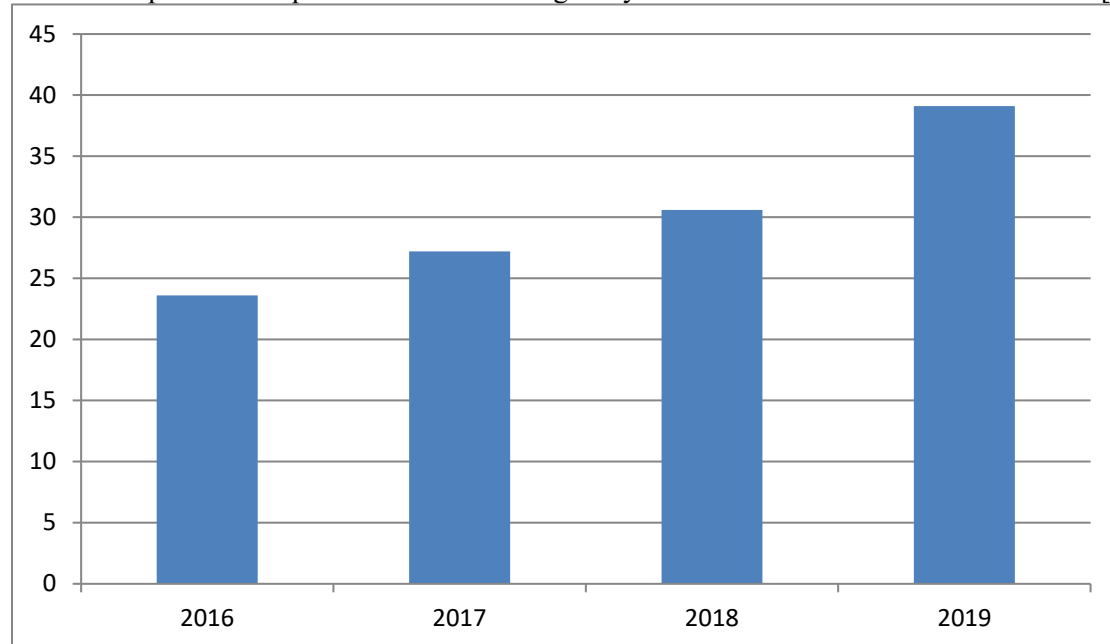


Figure 1. 2016-2019 China CNC machine tool output

#### 4.2 Update drawing software to enhance automation of NC machine tool design

CNC machine tool manufacturing is based on the use of industrial design. Industrial design requires frequent human-computer exchange. If the traditional sense uses artificial intelligence technology to assist, it will make the designer's work change from complex to simple. The most important thing is that product styling affects decision making. Technicians often find themselves in a dilemma at this stage. However, advanced intelligent auxiliary design can be added to make intelligent technology carry out targeted analysis on each mode to give technical personnel certain suggestions, which can make the final shaping work easier. For example, technicians can upgrade the drawing software in a targeted manner and adopt intelligent computer-aided design software. In the current engineering field, the use of computer-aided design software such as AutoCAD and Solid Works has been very mature. With the help of three-dimensional drawing modeling methods, it can better cope with the more complex and changeable characteristics of current engineering projects compared with traditional projects. Technicians can adopt intelligent computer-aided design software. The main composition of the software is to combine artificial intelligence with traditional design software. It has certain independent design, error analysis and horizontal comparative analysis capabilities. First of all, software should help designers effectively analyze the feasibility, reason about different design drawings, and verify whether the feasibility can meet the requirements of the current project. Secondly, the intelligent software should provide certain opinions on the finalization of the drawings, so that the project can meet the needs. The most important is that the intelligent design software must be creative. If the drawings designed by the technicians cannot meet the expectations, the intelligent design software can extract the relevant technical indicators of the CNC machine tool. It can find out the drawings with the highest similarity among all the drawings of CNC machine tool, and put forward

some constructive opinions, so that the technicians can develop the design thinking based on their original thinking.

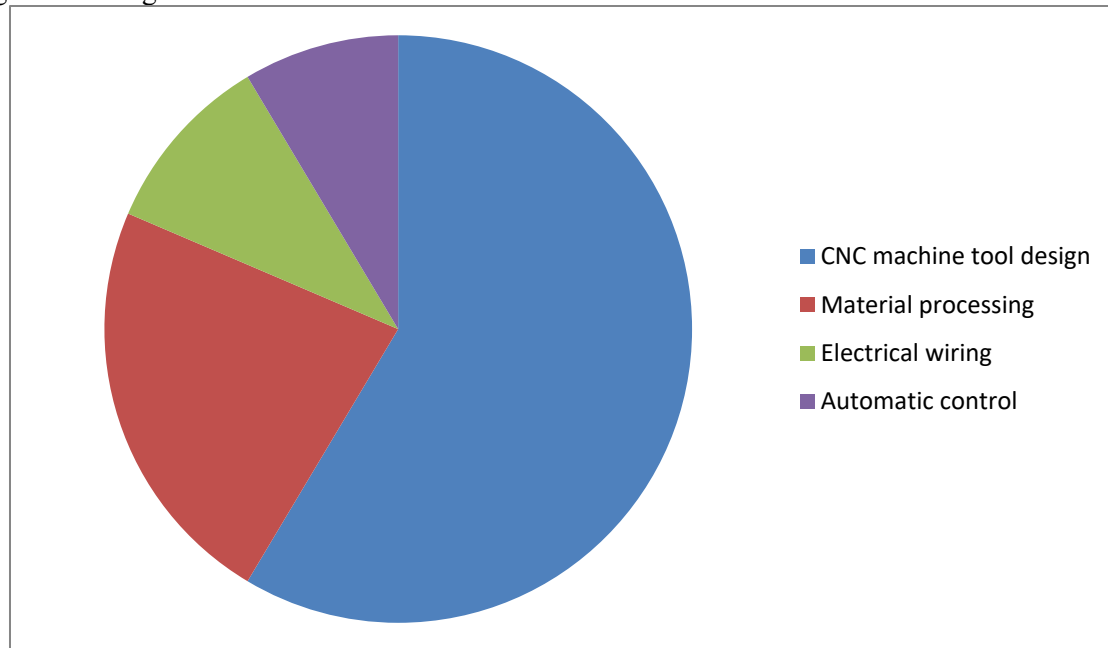


Figure 2. The use of CAD software in different industries

#### 4.3 Use intelligent technology to simplify with manufacturing standards

To expand the field, it must conform to the manufacturing standards of machine tool. On the basis of conforming to the standards, the machine tool should be innovated to the maximum. However, it should be noted that the design of the machine tool often requires the integration of a large amount of knowledge, which is a complex and huge project. A large number of technicians are required to make decisions on the next action and adopt the viewpoint agreed by most people to manufacture. If the whole decision-making can be simplified accordingly, the whole industrial design can be well simplified to greatly improve the engineering [4].

For example, technicians can construct corresponding knowledge modules and form an intelligent system based on the actual design. The technical personnel need to investigate the use of the CNC machine tool object, and the long-term use of the machine tool location also needs to be studied. The corresponding function of the machine tool should be added and deleted. According to customers' suggestions and requirements, it can control the manufacturing cost to improve the economy and environmental protection. It will make targeted changes according to market feedback on the machine. These key points are transformed by modularization, and the parameters of different machine tools are input into the system, so that the scale of the system is larger and the structure is more complete. At the same time, the internal structure design is important, including the machine tool shape and color and other external design links. Moreover, technicians also need to form knowledge modules with external factors, and add knowledge modules to form specialized systems. The computer can identify and specialize different projects according to the actual situation to simplify the decision-making. It can carry out targeted upgrading according to the previous scheme to improve the application efficiency.

## 5. Conclusion

To sum up, with the rapid economic development, the market competition of CNC machine tool has increased, and users have more individualized performance with aesthetics, humanization and comfort. Industrial design intelligent research has become the focus of CNC manufacturers. It is necessary to combine advanced modern skills such as computers and pneumatics as technical support with control

theory as the center. The staff need to combine the current status of CNC machine tool, innovate research directions and methods. Machine tool is more intelligent, digitized, and networked, and it promotes the sustainable development of industrial design intelligent technology.

**References:**

- [1] Shen Mingrui, Liu Kuo, Dong Haoqi. 2020. Reliability evaluation of CNC machine tool based on Bayesian [J]. Manufacturing Technology and Machine Tool, (1): 61-65.
- [2] Feng Jinjin, Deng Changyi, Zhang Jian. 2020. Research on the application of CNC machine tool data acquisition platform based on the Industrial Internet [J]. Manufacturing Technology and Machine Tool, (3): 124-129.
- [3] He Jianmin, Luo Jianxin, Zhong Wenjun. 2020. Error source analysis and compensation methods for CNC machine tool [J]. Modern Manufacturing Technology and Equipment, (2): 131-132.
- [4] Zhang Ting. 2018. Analysis on safe operation of CNC machine tools [J]. Safety Production and Supervision. 04.