Application of Computer Aided 3D CAD Technology in Mechanical Manufacturing and Automation

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Abstract. With the development of computer-aided technology, the application of computer-aided 3D CAD technology in mechanical manufacturing has become more and more extensive. And it has brought new breakthroughs to the machinery manufacturing industry. This article analyzes the characteristics and functions of 3D CAD technology and its application in mechanical manufacturing design, and it also analyzes the characteristics of mechanical automation control systems. In addition, this article also conducts research on the design of mechanical automation control systems.

Keywords: Computer Aided Technology, Three-dimensional CAD Technology, Mechanical Manufacturing, Automatic Control System

1. Introduction
In the new era of global economic development, the development of the machinery manufacturing industry has entered a new stage with the technical support of computer technology, Internet technology and various emerging technologies. In addition, with the application of automated control systems in the machine manufacturing industry, its development has reached a new height. Therefore, with the rapid development of science and technology, the application of various new technologies has effectively promoted the development of the machinery manufacturing industry, thereby providing more impetus for social and economic development [1].

2. Features and functions of 3D CAD technology
2.1. Improve the efficiency of machinery manufacturing
The 3D CAD software uses more advanced drawing software and drawing technology. Therefore, the mechanical structure drawing designed by this software can effectively improve the design speed, design efficiency and design quality. And when the mechanical design is carried out through this software, it can be constructed in advance based on the relevant information of the historical record, and the 3D CAD software contains many functions, which can effectively modify and perfect the design of some mechanical parts. In addition, the 3D CAD system itself has a wide range of deformable design capabilities, which can be used to quickly rebuild brand new mechanical products [2].
2.2. Process improvement of mechanical products
The use of 3D CAD software for model design in mechanical manufacturing can enhance the 3D effect of the mechanical part model, and the software contains better rendering capabilities and coloring capabilities. This can make the details of the mechanical parts more obvious, so that the designer can more clearly understand the appearance of the parts. At the same time, the use of computer 3D CAD software can also fully expand the designer's knowledge domain and improve the designer's memory [3].

2.3. Realize the save function
The 3D CAD software includes a save function, so that the designer can save the computer hard disk after completing the mechanical part design, which can effectively facilitate subsequent search. In order to save the design data of the mechanical product, the designer can burn the design file to a CD or use a scanner and digitizer to input the entire content of the design drawing into the computer. In addition, they can back up important data, which can also effectively avoid the process of mechanical manufacturing due to data damage or loss [4].

3. Application of 3D CAD technology in mechanical manufacturing design

3.1. Application in mechanical modeling design
The use of 3D CAD software for the design of mechanical related parts can allow designers to design more clearly and in detail, and the machine model built using this software is a three-dimensional model. This is also the main reason why this technology is widely used in mechanical construction scheme modeling. In addition, the 3D CAD software mainly uses frame technology, 3D technology and surface technology to model the machine structure, and the software also contains a lot of graphics related to the mechanical structure [5]. For example, two-dimensional figures such as circles, quadrilaterals, and triangles, and three-dimensional figures such as cylinders, cones, and ellipses. When the mechanical structure is too complex and diverse, 3D CAD technology can also use Boolean operations to arrange and combine the required graphics and patterns, and then perform comprehensive and systematic calculations according to customer requirements, and finally get the expected patterns and mechanical design schemes. This provides a strong reference foundation for the construction of mechanical models.

3.2. Application in the creation of mechanical construction plans
When the basic part of the mechanical design plan is completed, the designer should also check the details of the design plan, find the unscientific and unreasonable parts in the design, and then use the 3D CAD software to improve and repair. If the part is too complex, the designer must use the rotation method in the 3D CAD software to obtain a new part compatible with the arrangement and combination, so as to facilitate the formulation of a reasonable and scientific design plan. This can also ensure the perfection and smooth implementation of the mechanical design [6].

3.3. Application in mechanical CAE software
Optimizing structural design, analyzing design plans, and comparing plan data are the main functions of mechanical CAE software. A reasonable and scientific mechanical design plan is formed through these three points and evaluated. Only in this way can the standardization of the mechanical design scheme be guaranteed. First of all, the relevant personnel must do a good job of building the corresponding model, and then the mechanical CAE software is responsible for the design and analysis, so as to ensure the smooth implementation of the mechanical design plan. This is the entire application process of 3D CAD technology in mechanical CAE software [7].

4. Design of mechanical automation control system
4.1. Advantages of machine automation control
In the mechanical manufacturing process, the use of mechanical automation control systems can effectively control the entire mechanical manufacturing process, which can effectively improve the safety, reliability and automation characteristics of the mechanical manufacturing process. When a machine fails, the automation control system can find the source of the failure the first time. If the fault has occurred before, the automatic control system can quickly query the relevant historical records, and it will automatically solve the fault according to the solution method, so as to ensure the normal operation of the machine. If the fault is a new fault problem, then the automatic control system is to issue an alarm and stop other movements of the machine. This not only can effectively ensure the safety of machinery and staff, but also allows staff to find and check the source of the fault in the first time, so as to solve the fault problem in a faster time. Afterwards, the automated control system records the fault-related information into the database for subsequent use. In addition, the use of mechanical automation systems in production can increase production problems caused by human errors in the production process. Reliable automated monitoring equipment can improve product quality and production efficiency, reduce sales costs, and increase equipment profitability [8].

4.2. Establishment of mechanical automation control system
The establishment of mechanical automation control system mainly uses calculus. Figure 1 shows the construction diagram of calculus in the mechanical automation control system, which can determine the origin of coordinates, external force, displacement coordinates and other related information [9]. According to the principle and formula, the equation is finally obtained as shown in formula (1):

\[
M \ddot{x}(t) + B \dot{x}(t) + K x(t) = f(t)
\]  

(1)

![Figure 1. Calculus construction diagram of mechanical automation control system](image)

4.3. The three elements of a mechanical system
The three elements of the mechanical system include mass M, spring K, and damping B. The relevant force diagrams of the three elements are shown in Figures 2, 3, and 4, and the relevant formulas of the three elements are shown in (2), (3), and (4).
Figure 2. Quality effort map

\[ f_m(t) = m \frac{d}{dt} v(t) = m \frac{d^2}{dt^2} x(t) \]  \hspace{1cm} (2)

Figure 3. Spring force diagram

\[ f_k(t) = K[x_1(t) - x_2(t)] = Kx(t) \]
\[ = K \int_{-\infty}^{\infty} [v_1(t) - v_2(t)] dt \]
\[ = K \int_{-\infty}^{\infty} v(t) dt \]  \hspace{1cm} (3)

Figure 4. Damping force diagram
\[ f_B(t) = B[v_1(t) - v_2(t)] = Bv(t) \]
\[ = B\left(\frac{dx_1(t)}{dt} - \frac{dx_2(t)}{dt}\right) \]
\[ = B \frac{dx(t)}{dt} \]

\[ (4) \]

4.4. Module design of mechanical automation control system

The modular design of general mechanical automation control system is shown in Figure 5 [10].

5. Conclusion

At present, 3D CAD technology is a relatively advanced drawing technology, and its application in various design-related industries is becoming more and more extensive. Because the 3D CAD technology itself has the characteristics of intuitiveness, safety, and three-dimensionality, it has brought huge breakthroughs and influences to the design-related industries. But at the same time, it also brings greater challenges to all walks of life, which requires relevant researchers to continuously upgrade and improve the 3D CAD technology, so that it can be more widely used in the market.

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