

# *The Application of Simulation Software in Mechanical Numerical Control Machining Teaching*

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**Abstract:** With the continuous development of contemporary mechanical manufacturing technology, numerical control (NC) machining plays an increasingly important role in the entire machinery manufacturing industry. In order to further promote the development of NC machining, various colleges and universities began to strengthen the emphasis on mechanical CNC machining teaching. Among them, simulation software is widely used in teaching as an important technology in mechanical NC machining. However, there are various problems in the application of simulation software in the teaching of mechanical NC machining. In order to effectively promote the scientific application of simulation software, it is necessary to strengthen the research and analysis of simulation software. This paper analyzes the advantages and disadvantages of simulation software, and deeply studies the application and problem solving countermeasures of simulation software in mechanical NC machining teaching, which provides a reference for the better application of simulation software for mechanical NC machining teaching.

## **1. The advantages of NC simulation software**

### **1.1. Breaking the traditional way of teaching**

The traditional teaching method in the teaching of mechanical NC machining is to explain certain theories first, and then carry out practice teaching. Because the various programming codes involved in the theoretical knowledge of NC machining are different, the theory is difficult for beginners to understand, and even it will cause students to feel tired of learning. The numerical control simulation software inputs the complete program into the software. The running program is divided into two types: simple path simulation and actual processing. At this time, the simulation software will effectively introduce the theoretical knowledge of NC machining into multimedia teaching, so that students can observe the structure of NC machine tools from different angles. Students can not only understand the working principle of various parts of the machine tool, but also accurately observe the meaning of each instruction through the simulation software, thus helping students to understand the theoretical knowledge of mechanical CNC machining better and faster.

## **1.2. Reducing the cost of CNC machine tools and daily wear and tear**

In order to effectively promote the students' acquisition of NC machining skills, colleges and universities need to purchase NC equipment. The procurement of NC equipment needs to meet the requirements of teaching practice, and the equipment should be more advanced equipment, which makes the colleges and universities have more equipment purchase costs. The reality is that the funds of the colleges are insufficient, and only a small amount of numerical control equipment can be purchased. This will result in a large gap between student and machine. And the simulation software effectively ensures that each student is proficient in NC machining skills. Students can effectively understand the NC equipment through the numerical control simulation software, which is beneficial to students' proficiency in relevant skills. In addition, students will encounter wrong operations such as knife collision, illegal operation, and various alarms in the repeated application of simulation software. Students will learn some lessons from it, which will play a vital role in reducing the loss of equipment in the actual operation of NC equipment, thus greatly reducing the daily loss of NC machine equipment.

## **1.3. Effectively reducing the workload of teachers**

The traditional mechanical CNC machining teaching is the teacher explaining instructions. The teacher explains the programming through the description, which is not conducive to the students to understand the relevant programming well, and the workload of the teacher is greatly increased. Through the simulation software, the students can visually observe the programming very well, and the teacher can complete the programming teaching by operating the simulation software. In this way, teaching not only becomes more vivid, but also can improve students' interest in learning and can greatly improve the quality of NC machining teaching. In addition, in traditional programming teaching, teachers need to review the various programs submitted by students. Because students often use different programming when completing tasks, some will use fixed-cycle programming, and some will use sub-programming, which will transform the teacher's batch into a great workload, and the application of simulation software has greatly improved this problem. Through the simulation software, each subject can be evaluated, and the final workpiece shape of the programming can be visually seen, which greatly reduces the workload of the teacher.

## **2. The disadvantages of NC simulation software**

### **2.1. Arbitrary setting of Processing parameters, and poor product quality**

Simulation software has certain advantages, but it also has disadvantages. Since the numerical control simulation software is a relatively complete virtual process, as long as the program is correct in operation, there will be no processing problems, which makes the students develop the habit of setting the relevant parameters of the processing arbitrarily. Moreover, the simulation software cannot correctly judge the surface roughness of the workpiece, and the workpiece size measurement cannot be performed, and the dimensional accuracy cannot be corrected. This will cause the students to ignore these aspects in the actual operation of the numerical control processing equipment, thereby affecting the quality of the product.

### **2.2. Poor processing performance**

In the mechanical NC machining operation, some sorting and finishing of the machining process, analysis of design principle, and the clamping process of the demonstration special fixture are

involved. The application simulation software can not realize these steps, students cannot operate in person, and these are the difficult steps in NC machining, which will have a certain impact on the students' proficiency in NC machining operations.

### **2.3. Lack of on-site personal perception, and weak security awareness**

As a kind of operation with high risk coefficient, NC machining operation requires higher safety awareness of operators, but it does not show these dangers well in application simulation software, which is very easy for students to face with various dangerous situations in the actually operate. In addition, in the mechanical NC machining operation, the operator needs to have the corresponding listening ability, and can promptly identify the sound emitted by the machine under different conditions, and then adjust the parameters of the machine to reduce the probability of machine tool failure. The simulation software does not train the students' ability to distinguish, which also causes hidden dangers for various problems in the NC machine.

## **3. Ways to make up for the defects of numerical control simulation software**

### **3.1. Emphasize the importance of processing arrangements and strengthen practice**

In order to effectively improve the defects of the NC machining process, the arrangement of the processing technology should be strengthened in the actual teaching. In the teaching, we should explain the various aspects of the processing in detail, which part should be processed first in the NC machining, which part should be processed later, what specifications should be followed in the processing, and the need to carry out the clamping to ensure the processing Precision. In the teaching process, the practice of processing related operations should be strengthened, and specific NC machining operation instructions should be given.

### **3.2. Emphasize the difference between simulation software and NC machine**

Although the simulation software is a simulation of the NC machining machine, it is mainly aimed at the mainstream models and systems. In fact, the simulation software and the NC machining machine are not the same. There are some small differences between them, and if you don't care some differences, it is likely to cause a big accident. Therefore, in the teaching process, we should emphasize the difference between the simulation software and the actual NC machine. In the actual operation, we should strengthen the safety awareness and use the real machine as the main body of NC machining.

### **3.3. Deploy software usage time scientifically**

As an important teaching tool in NC machining teaching, NC simulation software plays an important role in the actual operation of students. In the teaching, the teacher can explain the key content of the theoretical knowledge in detail, and actively guide the students to use the simulation software for the first time, so that the students can master the programming of the simulation software, and thus promote the improvement of the NC machining skills by using the simulation software. NC machining machines are divided into different types. In order to effectively help students master the programming and knowledge of different NC machines, teachers need to explain and demonstrate different NC machining machines in detail to ensure students can operate the system on different machines. In addition, in the teaching process, teachers need to effectively combine theory and simulation software, and make the simulation software really play its role under

the premise of fully understanding the theoretical knowledge, thereby improving the teaching quality of NC machining.

### **3.4. NC simulation software is not a substitute for actual operation**

The numerical control simulation software effectively breaks the traditional teaching method, which has strong practicality, but the simulation software is only a simulation of the numerical control machining machine, and cannot really replace the actual machine. There is still a certain gap in some NC machining operations. For this reason, the simulation software cannot replace the actual machine operation in actual teaching. The numerical control simulation software can't make students feel the relevant operations of parts processing, and can't detect the actual operation ability of students. In addition, if students use the simulation software for a long time, it will easily cause dependence on the simulation software for them, which will lead to certain deviations in the actual operation. In serious cases, it will cause major accidents. For this reason, the application of simulation software cannot really replace the actual NC machining operation, and the simulation software should be effectively combined with the actual NC machining operation to achieve the purpose of improving teaching quality.

## **4. The Application of Numerical Control Simulation Software in Teaching**

### **4.1. Make up for the lack of equipment and save investment**

In recent years, colleges and universities have advocated practical teaching, and mechanical NC machining as a more practical teaching, it has more demand for numerical control equipment. In fact, due to the lack of funds and the large amount of funds purchased by NC equipment, this has made it impossible for colleges and universities to purchase NC machines in large quantities, resulting in a large gap between student and machine. The application of simulation software effectively solves this problem. Students can enhance the understanding of the NC machine in advance through the simulation software, and lay a solid foundation for mastering the operation process of the NC machine. In addition, students will inevitably have various problems in the initial stage of numerical control operation, and students who use simulation software can find their own problems in time, so that they can reduce the loss of machines in actual operation.

### **4.2. Create more hands-on opportunities, and high security**

Due to the limited number of NC machine tools in each college, there is no guarantee that each student can complete the entire operation process in practice, which is not conducive to the mastery of the relevant skills of students. With the application of simulation software, students can not only operate independently, but also have ample operation time. Students can exercise their own unskilled aspects to improve their proficiency in operation. There are many dangers in the actual NC machining operation, and in the simulation software, the teacher can emphasize the dangerous process in advance. In practice, students will be more careful and effectively improve the safety factor of actual operation.

### **4.3. Combine theoretical knowledge and mobilize enthusiasm**

The mechanical NC machining course itself is a practical course, which has high requirements for the practice of teaching. In the traditional teaching mode, the teacher only verbally describes the relevant procedures, which not only wastes a lot of time, but also is not conducive to students' good

understanding of knowledge. After applying the simulation software, the teacher can explain the CNC machining knowledge while demonstrating, which not only helps the students to better understand the relevant programming knowledge, but also greatly improves the teaching quality.

## 5. Conclusion

In summary, the simulation software is an important technology in the teaching of mechanical NC machining, which has been widely used in the structure and programming of NC machines. The simulation software not only effectively solves the contradiction between man and machine, but also greatly reduces the investment cost of NC machines in colleges and universities, and thus ensures that the simulation software has become an auxiliary tool for NC practical operation skills training. However, in the teaching process, it is necessary to strengthen the emphasis on the processing, so as to continuously improve the quality of the processing. And it is necessary to combine the simulation software with the actual NC machining machine. While fully exerting the function of the simulation software, it is also necessary to strengthen the operation of the actual NC machining machine. , and thus effectively improve the quality of NC machining teaching.

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