Application and Analysis of Computer Simulation in Machining Process

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Abstracts. Computer simulation technology is one of the key technologies in computer simulation industry. It is widely used in the world and is one of the key technologies in global competition. The application of computer simulation technology in mechanical processing can effectively improve the accuracy and efficiency of machining, and its value is prominent. In this paper, the general situation of simulation technology will be introduced as a starting point, and the specific application of this technology in the process of mechanical processing will be discussed comprehensively. The purpose is to improve the application level of computer simulation technology and ensure the overall quality of domestic mechanical processing.

1. Introduction

After years of development, China has leapt into a major machinery manufacturing country, manufacturing industry has become an important component of the national economy, a variety of new machining technology, equipment began to appear, which for development of machinery manufacturing has formed an effective impetus. Computer simulation technology, as a new manufacturing technology, is based on virtual reality technology, information technology and simulation technology to simulate the mechanical manufacturing system, so as to optimize the whole process of product development. It can realize the effective control of development cost and product production process. It is very beneficial to the development of mechanical processing industry.

2. Computer simulation

This technology belongs to the category of descriptive technology. It describes the system and process by constructing a system or process, and then draws the system characteristics by using computer simulation experiments, and obtains the corresponding quantitative indicators, so as to provide quantitative analysis results data for decision makers. This technology is based on system technology, similarity principle and other relevant fields of professional technology, using physical effects and computer, through the way of building system model, to test and research the imaginary or actual system. The application of this technology has the advantages of not limited by time, climate and site, and can be reused. The application level of this technology is relatively high in safety and economy, and has great application value.

At first, this technology was mainly applied in military field. Since 1990s, based on computer simulation technology, a batch of hardware-in-the-loop simulation systems with large scale and high
level have been constructed in China, which has effectively promoted the development of weapon models in China[^2]. At present, this technology has been widely used in people's lives and production. In 2008, the total scale value of this technology in the global market has exceeded 80 billion US dollars, and the overall industry development prospects are very ideal.

3. Application of Computer Simulation in Machining

Compared with the traditional manufacturing system, the application of simulation technology in mechanical processing is mainly based on intelligent computer simulation control mode, which is an effective breakthrough in manual control mode. Although the operation and design process of the system application are complicated in practical application, the advantages of the system application can not be ignored. Machining will become more accurate and scientific with the help of the system[^3].

At present, simulation manufacturing system is mainly divided into two kinds: special simulation language and general simulation language manufacturing system. The latter is a typical CSL system, which will carry out a large number of multi-functional programming operations in the design stage. All set sentences can be used to carry out content modulation in a single system. Each language can be used as a computer programming language and become a high-level language. The former system is a typical KUT system, which is based on a new simulation manufacturing technology system. The manufacturing system is simple to use and can be controlled as long as key data are input. In view of this, the manufacturing system, also known as data-driven simulator, is built on the basis of computer system, and its application effect in mechanical processing is ideal.

4. Application and analysis of simulation technology

4.1. Physical simulation

In the research of virtual manufacturing, forecasting and analyzing the physical factors of machining and cutting process is very important to the whole research. Scholars at home and abroad have paid more attention to the physical simulation of machining process. For example, Japanese scholars used elastic-plastic finite element method to simulate the residual stress distribution on the machined surface in the environment of neglecting the influence of strain rate and temperature; Chinese scholars used the results of two-dimensional finite element simulation of orthogonal cutting to analyze the cutting temperature field and tool load distribution, etc[^4]. Technicians will make comprehensive analysis of the corresponding parameters of the cutting simulation process, such as turning feed rate and geometric parameters, and use the three-dimensional finite element analysis software to analyze and study the data to determine the rationality of strain speed, temperature and other factors in the overall processing process, and make pertinent adjustment and optimization to ensure that the cutting construction can be practical and better, then provide a reliable guarantee for the final processing quality.

Through continuous efforts, finite element technology has been widely used in turning simulation operation, and the overall application prospect is very ideal. With the continuous development and improvement of finite element technology and computer technology, virtual manufacturing technology will be better applied in cutting simulation processing, the effect of turning process can be accurately predicted, the construction process will be effectively optimized, the selection of processing parameters and the quality of tool design guidance can be effectively improved, and the scale and number of processing tests in the research and development stage can be control effectively, the test cost and product development cycle will also show a significant downward trend, which will provide effective technical support for the development of mechanical processing.

4.2. Geometric Simulation

Geometric simulation technology is relatively mature, and the development of simulation module and simulation software provides more opportunities for the application of geometric simulation technology in mechanical processing. In order to properly solve the errors in manual selection of
processing parameters and ensure that the utilization rate of NC machine tools can be effectively improved, scholars in the industry have increased their research efforts on off-line parameter optimization technology and on-line adaptive parameter optimization methods. In the process of off-line parameter optimization, the processing parameters will be optimized by the way of predicting the processing state and combining the past experience and data before the specific processing. This method can not only optimize the determination of processing parameters, but also simulate the real processing process through the data processing simulation system, and then obtain the optimal parameters to ensure the final quality of subsequent machining. When offline parameter optimization is carried out, target setting and data model construction will be carried out according to the parameters of processing quality, processing efficiency and processing cost. At the same time, after choosing the parameters of the optimized object, the most suitable optimization algorithm will be used to determine the optimal parameters. Off-line variable parameter optimization is different from fixed parameter optimization. In optimization, feed rate is taken as design parameter, processing time is taken as optimization objective, and milling force is constrained. In fact, processing time and processing speed are not the only criteria to measure the production efficiency. The factors such as processing quality and cost will also have a direct impact on it. Therefore, when using the simulation system, not only the processing time and efficiency should be strengthened, but also the relevant factors should be adjusted, so that the processing parameters can be adjusted to the optimum level, and then the simulation system can achieve the best processing effect, and complete the practical optimization of the processing process. In addition, scholars in the field have also intensified the research on NC code optimization and verification of turning simulation. The application of simulation system will make machining more perfect.

4.3. Precision Machining of Parts and Components

Parts processing is the most important part of mechanical processing. The control effect of parts processing accuracy will have a direct impact on the use and performance of machinery. So parts processing is also the key part of the application of simulation technology. In this paper, the application of simulation technology in parts precision processing will be analyzed by taking the fitting compensation technology as an example.

When using the fitting compensation technology, the corresponding fitting parameters will be obtained by means of calculation, and the compensation processing will be carried out according to the specific position of the parameter information, so as to eliminate the angle error and diameter error of the parts and ensure the accuracy of the whole parts processing. Because the position errors of the round holes of parts have certain correlation in terms of conditions, eliminating the errors of single parts can effectively reduce the tolerance range of parts and determine whether the parts are processed in accordance with the standard. Therefore, within the corresponding tolerance range, compensation errors and radial errors of parts can be processed, and precise position analysis can be carried out to obtain precise data information. After analyzing the related contents of angle error compensation, if it is found that the circular hole is in the middle and beyond the normal hole position, the tolerance range should be analyzed at this time. If the position is less than the range, the point space position should be used to compensate the position of the balanced distribution hole, so as to ensure that the position difference after compensation can always be in the minimum range. In the specific operation, on the one hand, the maximum position hole should be searched, and its deviation direction should be determined, and the compensation length calculation should be carried out to determine the original step size of the part and the maximum compensation parameter value in the relative conditions; on the other hand, the angle of the template should be moved to the maximum position of the hole to calculate the maximum error value of the position parameters after and before moving, and the absolute value of the difference of maximum position after moving should be observed to determine whether there is a decrease in the difference, so that the calculation and adjustment can be carried out in time. If it is found that the maximum position difference parameter does not exceed the actual position difference or the step size does not exceed the target precision range, then the position...
compensation is no longer needed, otherwise, it needs to continue to compensate until the processing accuracy meets the corresponding standards.

5. Concluding remarks
In view of the advantages of computer simulation technology, the mechanical processing and manufacturing enterprises should strengthen the research and application of this technology. On the basis of defining the basic situation of technology and its application status, and according to the actual needs of mechanical processing, the technology science should be applied to the mechanical processing process to ensure that the technical advantages can be fully exerted. The simulation application effect can achieve the best, and then form an effective assistant for mechanical processing to ensure that the production quality of mechanical products can be effectively improved. Due to time constraints, the application of simulation technology introduced in this paper is not comprehensive, and only expected to provide some theoretical support for the application of technology.

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