

# Data Analysis Model of Machining Accuracy Measurement Technology for Machine Parts

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**Abstract.** The quality of mechanical products depends on the quality of mechanical parts and the assembly quality of products, and the quality of parts is the basis of assembly quality. The quality of mechanical parts is related not only to the performance of materials, but also to the accuracy of machining and the quality of machined surface. The accuracy of machining is an important index to evaluate the quality of parts. Due to various reasons in the process of processing, there will always be some deviation between the actual processed parts and the ideal parts. This deviation is called machining error. Machining accuracy and machining error are actually evaluated from two viewpoints on the same problem of part quality. The high or low machining accuracy can be expressed by the small or large machining error. In actual production, the aim of improving the quality of parts processing is often achieved from the point of view of reducing processing errors.

**Keywords:** Mechanical Parts, Processing, Accuracy, Measurement Technology, Data Analysis, Model.

## 1. Introduction

Machining accuracy mainly refers to all aspects of data of machined parts, including geometric shape, size and other aspects of compliance with or similar to the plan. The smaller the value compared with the planned part data, the higher the accuracy of the processed part. So in practice teaching, students can make simple parts processing and measurement after processing by themselves, so as to enhance students' initiative and interest in learning. In this way, students can not help accepting knowledge in the process of operation, and the degree of memory of knowledge is more profound, more easily applied to future practice.

In the production process of key engine parts, the processing quality of the parts is the guarantee of the overall performance of the engine, and the processing accuracy of the parts is one of the main factors affecting the processing quality. The factors affecting the machining accuracy of key engine parts are complex, and the machining errors of parts are the result of multiple factors. Therefore, it is impossible to draw a conclusion from the detection of a single part. Usually, it is necessary to check a batch of parts processed, collate and analyze the measured data, and finally get the distribution law of the processing errors of parts, so as to control the processing quality of parts and improve the processing accuracy of parts. In this process, if only manual completion of these data statistics, calculation, analysis and so on, it seems quite complex and cumbersome, sample size is limited and error-prone, both time-consuming and labor-intensive, increasing labor costs.

With the continuous development of modern industry, there are higher and higher requirements for processing accuracy in mechanical processing. Therefore, it is of great significance to better guarantee the machining accuracy of mechanical parts. In the manufacturing process of mechanical parts, in order to ensure the processing accuracy, the processing technology should be measured by related technologies. On this basis, we can better measure the processed parts, ensure the accuracy of the processing accuracy, and improve the processing accuracy of the parts.

## 2. The Proposed Methodology

### 2.1 Machining Accuracy of Mechanical Parts.

Machining accuracy of mechanical parts refers to the degree of conformity between the actual dimensions and geometric parameters of mechanical parts and the dimensions marked in the drawings, while the machining error of mechanical parts mainly refers to the degree of deviation between the

actual dimensions of mechanical parts and the dimensions marked in the design drawings. In the process of mechanical parts processing, we should try our best to improve the processing accuracy of mechanical parts to reduce the processing error of mechanical parts, so as to improve the manufacturing accuracy and service life of mechanical equipment.

Errors in the processing of mechanical parts due to the approximate method and mechanical parts need to be clamped and positioned in the process of processing, and the errors in the process of mechanical parts processing due to the inadequate clamping are called clamping errors.

Machine parts are mainly processed by machine tools. Therefore, the machining accuracy of machine tools will affect the processing accuracy of machine parts. When machine tools have various errors, the machining accuracy of machine parts will be greatly affected. Among the errors of machine tools, the main errors are machine tool spindle error, guide rail error and guide rail. The positioning accuracy error is affected by many factors.

In the manufacturing of mechanical parts, as the main cutting tool, the manufacturing accuracy, clamping accuracy and wear degree of the tool will have a greater impact on the machining accuracy of mechanical parts.

In the process of mechanical parts processing, machine tools, fixtures, cutting tools and the parts to be processed are jointly processed in the mechanical parts processing.

A unified system is formed in the process of construction. This system is called process system. When the process system is subjected to external force and heat, the mechanical processing of mechanical parts will be greatly affected. When the process system is subjected to external force and heat, it will lead to certain deformation of mechanical parts. This kind of deformation will ultimately affect the processing accuracy of mechanical parts.

During the clamping and processing of mechanical parts, the mechanical parts will be affected by the superposition of external cutting forces, clamping forces and the gravity of the mechanical parts themselves. The existence of these forces will cause the mechanical parts to be deformed after processing. In addition, in the mechanical processing of mechanical parts, the cutting between the tool and the workpiece will be produced. Cutting heat will make mechanical parts easy to produce thermal deformation. In addition, in the process of mechanical parts processing, the residual stress of mechanical parts after processing, measurement errors and operation errors in the process of mechanical parts processing will have a greater impact on the processing accuracy of mechanical parts.

Machine tools are the basis of machine parts processing and an important factor affecting the accuracy of machine parts processing. In order to reduce the impact of machine tools on the accuracy of machine parts processing, efforts should be made to improve the geometric accuracy of machine tools and the accuracy of measuring tools and fixtures for corresponding workpieces, and to reduce the impact of additional forces and other wear and tear deformation on machine parts in the process of processing. The original error caused by internal stress and so on. To do a good job in the maintenance of machine tools and the maintenance of daily production, the use of angle rulers, inspection rods and other accuracy indicators of machine tools to test, to find problems to be solved in time, improve the mechanical accuracy, geometric accuracy and rigidity of machine tools, and in the process of processing mechanical parts to adopt appropriate measures to control the processing of thermal deformation of mechanical parts. For the processing of mechanical parts with formed surface, the most important thing is to reduce the processing error of mechanical parts caused by improper installation of forming cutter and tool.

## **2.2 Factors Affecting Machining Accuracy of Machine Parts.**

In the manufacturing process of mechanical parts, the processing accuracy of parts will be affected by many factors, which will have a relatively negative impact on the quality of parts. Specifically, in the manufacturing process of mechanical parts, the factors affecting the processing accuracy mainly include the following points.

Firstly, the geometric accuracy of the machining process system is affected. Machining process system of mechanical parts mainly includes machine tools, cutting tools, fixtures and parts. The

influence of geometric accuracy of process system on part processing accuracy mainly includes five aspects: machining principle error, adjustment error and machine tool error, as well as fixture manufacturing error and tool error. Among these factors, the most obvious one is the error of machining principle. That is to say, in the process of machining parts' surface, for some special shape cutters, their routes can only reach approximate values and there are errors.

Secondly, the factors of force and deformation influence. In the manufacturing process of mechanical parts, it will be affected by clamping force, cutting force and gravity and other related factors. This often results in the deformation of the process system, and changes in the relative position between the tool and the blank, which leads to the formation of processing errors, and then affects the actual processing accuracy of mechanical parts. In addition, the change of process system will not only reduce the machining accuracy of mechanical parts, but also affect the surface quality of parts to a certain extent, resulting in the reduction of the production efficiency of parts. Usually, the process system produces elastic deformation after being stressed, and the stronger the resistance to elastic deformation, the higher the processing accuracy of parts.

Thirdly, the influence of thermal deformation factors, the so-called thermal deformation refers to that in the process of manufacturing mechanical parts, the processing system is often affected by various aspects of thermodynamics, resulting in temperature deformation, which will affect the tool and parts to a large extent, and thus will have a serious impact on the processing accuracy of mechanical parts. In the process of machine parts processing, it mainly includes two aspects of heat sources, namely internal heat source and external heat source. Both of these heat sources will greatly affect the processing accuracy, especially for some more precise parts, the error caused by thermal deformation occupies a large proportion. Therefore, it is necessary to measure the machining accuracy in the process of machine parts processing, so that the processing quality can be better guaranteed.

Steel rulers and calipers are two widely used tools in measuring the machining accuracy of mechanical parts. Steel ruler is made of stainless steel plate. It is mainly used in length measurement and can measure the length data of parts flexibly. Usually, the accuracy of steel ruler is millimeter, so it is more suitable for parts with millimeter as measurement accuracy error. Caliper is an indirect precision measurement tool. Generally, calipers include two types: internal calipers and external calipers. The internal calipers are mainly used to measure the inner diameter and grooves of cylindrical parts, while the external calipers are mainly used to measure the outer diameter and related plane data. However, in actual measurement, it should be noted that these two tools cannot read the measurement results directly, so they need to cooperate with other calibration tools to implement reading.

Vernier caliper is also widely used in precision measurement of mechanical parts. It belongs to a measuring tool with relatively high accuracy. This measuring tool is more convenient in practical application, so it is widely used in actual measurement. Generally speaking, vernier calipers mainly measure the external diameter, internal diameter and related geometric parameters of parts. Currently, vernier calipers mainly include two kinds of accuracy, namely 0.02mm and 0.05mm. Micrometer is a kind of relatively precise measuring tool. Compared with vernier caliper, micrometer has higher accuracy and higher sensitivity in practical application. Therefore, micrometer has a very wide application in the process of measuring instruments with higher accuracy requirements, and shows obvious advantages in practical application.

In the process of measuring the machining accuracy of mechanical parts, the percentile meter is a special measuring tool. The data obtained in the measurement process is relative data, not absolute value. Generally speaking, percentile meter is widely used in measuring position error and shape error of mechanical parts, such as measuring flatness, roundness, verticality and runout frequency of parts. The precision of the measuring tool is 0.01 mm. The dial of the dial in the percentile meter consists of 100 cells, with two pointers. When the big pointer rotates one circle, the small pointer rotates one grid, which means that the side bar moves one millimeter. So, when reading percentile meter, it includes three steps: first read out the small pointer scale value, and then read out the large pointer scale value, and then read out the scale to 0.01 mm, then add up the two readings, and the final reading is the measured data. The application of plug gauge in the measurement of mechanical parts is mainly

to measure the gap size between the joints of mechanical parts. The composition of plug gauge is mainly a group of thin steel sheets, and each steel sheet has a certain difference in thickness. At the same time, the steel sheet contains thickness markers. In the process of measuring the machining accuracy of mechanical parts, steel sheets can be superimposed according to the actual situation to make them fully fit the gap of the parts, then the gap value is the thickness value of the superimposed steel sheets, so that the size of the gap on the fitting surface of the parts can be better measured, the accuracy can be better judged, and the existence of errors can be determined.

### 2.3 Statistical Analysis of Machining Accuracy.

With the advancement and development of virtual instrument technology, new research vitality has been brought to the subject of computer aided machining accuracy analysis. Virtual instrument has great programming convenience, strong function and flexibility, especially in comprehensive measurement, data processing and graphical display. Based on this, a virtual instrument system for measuring and statistical analysis of Parts'processing accuracy is designed. The system is used to measure and analyze the machining errors of mechanical parts. The system can detect and analyze the errors timely and accurately. It can greatly shorten the time of measuring workpiece and statistical analysis, so that operators can timely understand the working state of the process system, the trend of processing errors and the influencing factors of processing errors, so as to adjust the process system in time and realize online measurement and real-time analysis of processing errors.

In the process of machining mechanical parts, besides improving the processing accuracy of the blank parts of mechanical parts or the processing accuracy of the upper process, etc.

In addition, to improve the processing accuracy of mechanical parts, it can also be grouped by grouping the blanks of mechanical parts according to their size error, thus reducing the error of the blanks of mechanical parts to the original  $1/N$ . According to the average size of each group, the position and accuracy of the cutting tool and the corresponding fixture are adjusted. Thus, the size error dispersion range of mechanical parts can be reduced, which brings convenience to the subsequent processing of mechanical parts and improves the processing efficiency of mechanical parts and ensures the processing quality of mechanical parts.

Micrometer is a relatively precise measuring tool. Compared with steel ruler, the calibration accuracy of vernier caliper is higher than that of steel ruler, reaching 0.01 mm. Compared with vernier calipers, the micrometer has a higher measurement accuracy and a higher sensitivity, so it is necessary to use micrometers when measuring mechanical parts with high accuracy requirements.

Among the commonly used measuring tools, the percentile meter is a special measuring tool. The data measured by the percentile meter is a relative data, not an absolute value. Percentimeters are generally used to measure the position and shape errors of mechanical parts, such as flatness, roundness, verticality and runout frequency of parts. The accuracy of the percentile is 0.01 mm.

Plug ruler, also known as thick and thin ruler, is generally used to check the size of the gap between the two joints of mechanical parts. Plug ruler is composed of a group of thin steel sheets, each of which has different thickness, and has corresponding thickness markings on the steel sheets. In the process of measurement, if one or more pieces of steel are superimposed to fit perfectly with the gap of the part, then the value of the gap is the value of one piece of steel or multiple pieces of steel superimposed.

## 3. Conclusion

Mechanical parts are an important part of mechanical equipment, and their processing accuracy has a direct impact on the manufacturing quality of mechanical equipment. In the mechanical processing of mechanical parts, it will be affected by many factors, such as machine tool itself, processing technology, mechanical force and thermal stress. Based on the analysis of the common factors affecting the processing quality of mechanical parts in the process of processing, this paper elaborates on how to improve the processing quality of mechanical parts and related measures. In the manufacturing process of mechanical parts, the processing accuracy is a very important content. It

will have an important impact on the overall quality of parts, so it is very important to ensure the processing accuracy. In the process of machining mechanical parts, the factors affecting accuracy should be reasonably analyzed.

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