

# Research on The Design Method of Auto Induction Rearview Mirror

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**Abstract:** Reverse engineering is an important branch in the field of mechanical design and manufacturing. This paper introduces reverse engineering technology and its working process, including digital processing, three-dimensional modeling, manufacturing, measurement and inspection, and so on. Taking the rearview mirror of an automobile as an example, it focuses on its digital processing and modeling.

**Keywords:** Reverse engineering technology, Design and manufacturing, Car rearview mirror, 3 d modeling.

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## 1. Introductions

Reverse engineering is an important branch in the field of mechanical design and manufacturing. It is often used in the design and processing of parts with complex shapes. In the use of reverse engineering technology, the manufacturer generally has only the material prototype, in the absence of any geometric characteristics data can be used for mold or product design and development; At the same time, the existing mold can also be repaired by means of CMM [1]. With the wide application of computer technology in the field of manufacturing, especially the rapid development of digital measurement technology, in the design and manufacture of parts, the use of reverse engineering technology can greatly shorten the product development cycle and cost [2].

The design idea of reverse engineering is to design and produce according to the existing prototype of parts. The geometric characteristics and technical parameters of parts are all included in the prototype of parts. Modeling is carried out by measuring the data value of each point on the part, and cutting is carried out by the machine tool after generating the corresponding code. Contrary to the traditional parts mapping, CAD drawing, design calculation, process analysis and cutting, it is suitable for the design and manufacture of curved parts such as automobile mirrors [3].

## 2. Reverse Engineering and Its Working Process

Reverse engineering is compared with the traditional product design process, it is from the existing components or mold, through such as three coordinate measuring machine and other equipment for mold data, mathematical models of the parts were refactoring, product modeling, using CAD software generated using CAM software instructions, by NC processing into the mold. Its main work can be divided into digital processing, three-dimensional modeling, manufacturing, measurement and inspection [4].

(1) Digital processing. The extraction of 3D data information is an important content in reverse engineering. 3D coordinate values of components are obtained by CMM and other equipment, that is, point cloud data is obtained by scanning. The data usually need to be preprocessed to enhance its rationality and completeness. In the process of data acquisition, we strive to collect data on the basis of one

positioning, so as to avoid errors caused by multiple positioning and multi-view assembling. According to the point cloud data, the curve was fitted by CAD software [5].

(2) Three-dimensional modeling. The reverse engineering modeling of the workpiece is based on the original parts or molds for product design, which needs to go through the steps of data acquisition, modeling scheme determination, data preprocessing, characteristic parameter extraction, CAD modeling, parameter modification and innovative optimization design. Most parts designed based on reverse engineering are composed of some surfaces. The modeling method should be selected according to the topological relationship of surfaces and point cloud data. It CAN BE MODELED IN computer OR BY HAND according TO THE data OBTAINED by scanning, and it can reconstruct and calculate features according to the extracted feature design parameters, and attach innovative design ideas. Before part modeling, point cloud data need to be preprocessed, which has a direct impact on modeling quality [6].

(3) Processing manufacturing. After the modeling is completed, in the selected CAM software, the machining method is selected according to the shape of the surface, the tool model is determined, and the required processing parameters are selected to implement the cutting [7].

(4) Measurement and inspection. The digital processing and 3D modeling of the parts have high accuracy, but due to the errors of the processing system, such as the errors of machine tools and cutting tools, there will be some errors in the processed parts, that is, the processing error of the reverse product. The measurement and inspection method is to import the data file of the product into UG software, compare it with the data generated by UG, and conduct qualitative and quantitative analysis of the error, so as to realize the quantitative inspection of the product [8].

## 3. Typical Parts Modeling Case Analysis

The rearview mirror mold of a car or motorcycle is a curved shape, which belongs to an irregular shape and contains innovative design ideas. It is a typical case of reverse engineering technology design and manufacturing, as shown in Figure 1. It uses UGNX6.0 for styling design.



**Figure 1.** Rearview mirror model

The three sides of the rearview mirror using stretch, the top surface can be used mesh, the form of each round corner is not consistent, need round corner bridge, determine the stereo dividing line of the rearview mirror, and dividing line as the boundary, the tilt direction on both sides is opposite. When the corners are rounded, the corners on both sides of the parting line should be repaired. The rearview mirror support frame also needs to determine the classification line, and some parts after classification need to be further decomposed according to the modeling needs.

The rearview mirror adopts BQC1086R compound coordinate measuring machine to digitize the workpiece. When collecting data, the workpiece is placed on the workbench and fixed, and the curved surface and support frame of the workpiece are measured to obtain the point cloud of its contour, and the spatial coordinate system of the workpiece is established to obtain the required point cloud data through system software processing [9].

The point cloud data of components obtained by CMM need to be preprocessed. Due to the influence of various factors, there will be some data noise, and these noise points need to be processed. The purpose of data preprocessing is to obtain relatively complete point cloud data through denoising, filtering and other editing work on the original point cloud data, so as to meet the needs of subsequent modeling. In this case, the reverse engineering software Surfacar is used to process the point cloud data [10], and the surface of the mold contour is constructed using the surface construction tool of the point cloud, and then different surfaces are formed into entities by surface intersection or surface transition.

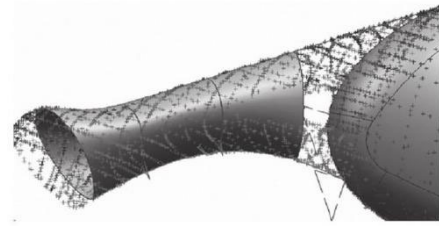
Part modeling. Parts form a series of space discrete points after digital processing, modeling is on the basis of these discrete points, the application of computer design technology, the construction of parts prototype CAD model. In general, it is not feasible to fit all data points with one surface for complex profiles containing free surfaces. Generally, the measured data points should be divided into different areas according to the characteristics of the prototype. Different surfaces are fitted to each region, and then the different surfaces are connected to form a whole by the method of surface intersection or transition between surfaces. Effective 3D measurement data segmentation and fitting technology is the first content in reverse engineering. After obtaining the relevant data of the parts, UG software is used to process the collected data to obtain the solid model of the car rearview mirror. The specific modeling ideas and steps of automobile rearview mirror are as follows:

The reconstruction method of surface model should be selected according to the topological relationship of surface and the characteristics of point cloud data. In this case, according to the internal structure of the sample, the normal line of the bottom plane is determined as the drawing direction, and the plane is determined by stretching or three points. The three sides of the rear view mirror head part are

stretched, and the top surface is gridded. At the same time, the main profile of the rear view mirror head is determined, which is bounded by the parting line and tilted in opposite directions on both sides.

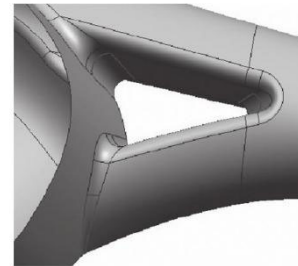
(1) Analyze the surface topology structure of the sample. The topological relationship between the construction line and the top plane, the plane of the construction line should be approximately perpendicular to the surface to be constructed; Surface quality is mainly smooth, precision is auxiliary.

(2) Surface quality analysis. The construction lines should be uniformly arranged as far as possible, and the height of the curvature comb should be aligned to ensure the smoothness of the surface. The position of the parting line should not be tangent, and all other positions should be tangent, as shown in FIG.2.



**Figure 2.** Layout rules of construction lines

(3) The rear view mirror support frame part should be paid attention to. The endpoints of the inner part of the profile line must be located on the main body parting line and on the same plane; Check whether the surface near the parting line is inverted, pay attention to the curvature of the curve or the curve on the surface; The position of the time division line of the mesh complement should not be tangent, and all other positions should be tangent, as shown in Figure 2.



**Figure 3.** Connection between the rear view mirror head and the support frame

In the design software, the curvature method can be used to analyze the surface in the analysis module. When the surface curvature changes uniformly, the surface is considered to be smooth, and then imported into the Surfacar for error analysis, and the model is gradually adjusted according to the error. If the surface quality is very poor, the curve should be readjusted until the model meets the design requirements of the final product.

(4) Parts processing and manufacturing. After the modeling of the rear view mirror and the support frame is completed, the die design module of the software is used to establish the parting surface of the punch and the concave die, and the die cavity of the parts can be obtained by considering the shrinkage coefficient. The next step is manufacturing. According to the process characteristics and surface shape of the parts to choose the processing mode, set the process

parameters and processing tools. After the file is imported into NC, the entity processing of the parts can be completed. After the parts pass the inspection, the rearview mirror parts model can be obtained.

#### 4. The Conclusion

Using reverse engineering technology to carry out innovative design is a comprehensive task involving many technologies, using many kinds of equipment and using many kinds of software. The 3D coordinate measuring machine is used to digitize the rearview mirror of automobile, and CAD modeling is carried out on the workpiece. Based on this, the product design is carried out. It can not only copy the physical prototype, but also modify and design new products. This technology is suitable for the design, production and manufacturing of a series of products in the manufacturing field of small batch, many varieties and rapid shape change, and shortens the production and development cost and production cycle.

#### Acknowledgment

Thanks the following funds for their support:

2020 school level science and technology plan project, Fund No.: 2020KJ02.

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