Research on Modeling of Cutting Parts Based on Solidworks

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Abstract. The article elaborates the significance of the cutting feature in different ways, the shape structure and modeling approach of cutting feature are analyzed through examples. The modeling method is summarized: 1) According to the projection relation, the wire frame is separated. According to the projection of view, the positional relation of each plane is analysed, the corresponding plane of the wireframe is determined the shape of the cut is clarified. This is the key to deciding whether the modeling can be completed successfully. 2) By imagining the shape, the position and order are determined. By line-plane analysis and dimensioning, the cutting position and order of the surface are determined, and the shape and structure after cutting are clarified. This is an important basis for rapid modelling. 3) Thinking overall. Repeatedly compare the shape with the views, and comprehensively check to ensure that the feature position of the shape is clear, the shape is accurate, and the structure is complete.

1. Introduction
Modeling is to build a model, which is an abstraction and a written description of things in order to understand things. In other words, modeling is a simplification of reality.

Why modeling? For example, if you want to produce a part, you must first design a sketch, plan the size, shape and structure of the part, and make corresponding drawings and models. Maybe you suddenly have a better idea like this in the planning, you can continuously modify the drawings and models, and then process them until you are satisfied with the drawings and models. This can not only produce satisfactory parts but also improve production efficiency.

The structure of cutting parts is relatively complicated. Through analysis, the characteristics and modeling methods of this type of shape are summarized, which provides an effective basis for quickly and accurately completing the modeling of such parts.

2. Software Introduction
Solidworks software is the world's first Windows-based 3D CAD system. It is a mechanical design software. It is a CAD/CAE/CAM software with design functions. Its interface operation is completely Windows-style and has a user-friendly interface.

Solidworks has three major characteristics: powerful, easy to learn and use, and technological innovation, which makes Solidworks a leading and mainstream 3D CAD solution. Solidworks can provide different design solutions, reduce errors in the design process and improve product quality. Solidworks not only provides such powerful functions, but for every engineer and designer, the operation is simple and convenient, easy to learn and use.

With powerful design functions and easy-to-learn and easy-to-use operation coordination, using Solidworks, the entire product design is editable, and part design, assembly design and engineering drawings are all related.
3. Cutting Feature

From the point of view of engineering drawing, cutting feature is a kind of structure form of parts, which is summarized for the convenience of analyzing parts.

Part is the basic unit of the machine, part through the chamfering and other simplified operations to get a composite body, that is to say, composite shape is a simplified abstract typical parts model.

The combined forms of the combined shape include superimposed, cut and integrated. A clear and effective analysis of the composition form of the assembly, choosing an effective method to read the drawing, is very helpful to understand the view of the combination, so as to lay a solid foundation for understanding the part drawing and 3D modeling.

From the perspective of three-dimensional modeling, the cutting feature is a method of software modeling and a feature generation method that removes materials. It can effectively realize the structural features of the part's punching and grooving.

For example, modeling features such as extruded cut and revolved cut. Part features must be analyzed at the beginning of part modeling, which helps to understand the structure of the part and generate 3D models accurately and quickly.

4. Modeling Analysis of Cutting Parts

Observe the view, analyze the structure, Figure 1 shows the front view, top view, right view and isometric view of the shape. The analysis from the right view shows that the a, b and c planes of the shape are all inclined planes, d is the vertical plane, and e is the horizontal plane. It can be seen that the planes a, b, and c are inclined planes obtained by cutting a rectangular, so the coordinate system is set at the lower right back corner of the rectangular, as shown in Figure 1, to facilitate the analysis of the shape structure.

![Figure 1. (a)three views (b)axonometric](image)

This shape is obtained by cutting multiple times on the basis of a rectangular parallelepiped. According to the view, it can be seen that the front side c, rear side a, bottom surface b, and upper left side e all need to be cut, but the order of cutting needs to be determined in detail.

Part cutting is generally carried out on the basis of the basic body. Through the view analysis, this shape is cut on the basis of a cuboid. The three faces a, b, and c are perpendicular to each other, but are inclined to the coordinate plane, so these three faces are formed by cutting. Furthermore, it is analyzed that the intersecting planes around the b and c planes are all cutting planes, and the position is not easy to determine. The a plane intersects the b and d planes respectively. The d plane is the back of the cuboid, which is a vertical plane, so the a plane can determine the accurate starting point. The position starts from point A, and the inclination angle is 20° as shown in Figure 1. This determines the position of surface a. Point a is not given a size and needs to be determined by surface e. The projection line of surface e in the right view passes through A Point, so the position of point A is determined, so in the cutting sequence, you should cut surface e first, so as to determine point A, then cut surface a, and then cut surface b and surface c. The cutting modeling of the main surface can be completed.
The modeling process of the part is as follows:

Before cutting, construct a solid cuboid. The length, width and height of the cuboid is the direction of the coordinate axis. As shown in Figure 1, it can be seen that the edge of side length 200 is the side parallel to the coordinate axis X, the bottom side 80 and the back side The sides 120 are not parallel to the coordinate axis, so the cuboid cannot be constructed with 80 and 120 as the side length, so a 200×200×200 cuboid can be constructed. As shown in Figure 2, this shape is larger than the cutting shape and is ready for subsequent cutting.

According to the given size analysis, first cut the left top e, that is, cut 60X36x200, as shown in Figure 3, and then cut the back side a, the cutting surface must pass A point, and the angle θ with the Z axis is 20°, The key point A is collinear with the ridge line of the left recess in the figure, as shown in Figure 4.

![Figure 3. Cutting the upper left e](image)

![Figure 4. Cutting back side a](image)

According to the given size analysis, first cut the left top e, that is, cut 60X36x200, as shown in Figure 3, and then cut the back side a, the cutting surface must pass A point, and the angle θ with the Z axis is 20°, The key point A is collinear with the ridge line of the left recess in the figure, as shown in Figure 4.

![Figure 5. Plane Projection of the auxiliary line](image)

Then cut the bottom surface, according to the size requirements, pass the upper right corner of the body, make an auxiliary line, and make an angle of 20° with the upper surface projection, and then make an isometric line of 120mm, as shown in Figure 5 and Figure 6, the isometric line Cut off the lower half, and cut out the bottom bevel side b, as shown in Figure 7.

![Figure 6. Axonometric projection of auxiliary line](image)

![Figure 7. Cut out the bottom bevel B](image)
Figure 8. Isometric lines for edges

Make the equidistant line of the ridge line of the back side inclined plane a with a distance of 80mm, as shown in Figure 8. Cut off the front side of the equidistant line to obtain the front side inclined plane c, as shown in Figure 9.

Figure 9. Cut out the bevel c

Figure 10. The first cut

Figure 11. The second cut

Then cut the upper part of the front side, which can be cut twice to obtain the shape shown in Figure 10 and Figure 11. Then add the bottom boss, as shown in Figure 12, continue to cut two holes and a slot to complete the part, as shown in Figure 13. Finally, the fillet is completed, and the shape of the entire part is shown in Figure 14.

Figure 12. Increase bottom boss

Figure 13. Cut out holes and slots

Figure 14. Complete shape structure

Through the analysis, the modeling process of the shape is shown in Figure 15. The rectangular --multiple cuts--round corners--complete the shape modeling.
5. Conclusion
Modeling method of cutting-type Parts:
1) According to the projection relation, the wire frame is separated. According to the projection of view, the positional relation of each plane is analysed, the corresponding plane of the wireframe is determined the shape of the cut is clarified. This is the key to deciding whether the modeling can be completed successfully. 2) By imagining the shape, the position and order are determined. By line-plane analysis and dimensioning, the cutting position and order of the surface are determined, and the shape and structure after cutting are clarified. This is an important basis for rapid modelling. 3) Thinking overall. Repeatedly compare the shape with the views, and comprehensively check to ensure that the feature position of the shape is clear, the shape is accurate, and the structure is complete.

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7. References
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