

The methods of placing background image in Rhino

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Abstract. When using Rhino software for computer aided design, designers often place and manipulate background images in the viewports for tracing or design analysis. It is a problem in determining the size and location of the background images. Three methods are provided. The purpose of the paper is to provide a new thought for the designers.

1. Introduction

Rhino is a professional 3D modeling software developed by American Robert McNeel & Assoc. The newest version is Rhino5.0. It has powerful 3D modeling function, simple interface, ease of operation and it has great advantage for fast and accurate performance design. Combined with the corresponding plug-in, the software is widely used in industrial design, architecture design, jewelry design and mechanical design and other fields of design practice and scientific research [1].

In the conceptual design stage of the industrial products, the advantage of Rhino NRBS modeling is obvious. In 3D reconstruction of design sketch, the adaptability for free form surface modeling ability is stronger and the performance of design concept is better, which makes the designer express their design vocabulary more freely [2]. During modeling and according to the idea of “dotting - staying - paving - combined with body” [3], the first step will depend on the reference. Draw the key characteristic curve precisely and make it to be the benchmark of 3D modeling of product. The quality of these lines determines the final quality of 3D model [4]. Therefore, if it is accurate to place background image, directly affect the progress and quality of modeling. It is a problem in determining the size and location of the background images in practice. This article will combine the author's practical experience to introduce different methods aiming at the actual operation of common problems in order to improve the quality of modeling and design efficiency.

2. Common problems of placing background image

Rhino has strong adaptability in free surface modeling, so we need to choice thoughts flexibly according to different objects or different purposes of modeling. No matter how excellent the tool is, it can't complete the design task efficiently without modeler's clear modeling thought and logical thinking [5]. The operation of the Rhino simplicity does not represent the random modeling ideas. It is



a necessary guarantee that the user fully understands the final shape and the surface before modeling to map the ideal line. Similar to the structure sketching, we need to target shape form a complete concept and awareness including all the shapes, lines' forms, and the transition relationship between line and line, between surface and surface and so on. The effectiveness of the logical thinking can be reflected when placing bitmap [6].

The basic steps of placing background image are placing the prepared images of all views in the corresponding view as background reference and then adjusting them to the right position and size so that we can observe product modality and interpret the conceptions of models visually for analyzing [7] and making models step by step.

Due to different purposes (just like improved design according to the existing or innovative design according to the design draft), the source of image and the complexity of the modeling objects (such as a USB flash disk or a car) are different. Who lacks experience always lacks effective means and methods when placing background image. Two problems often appear. One of them is starting placing reference image without clear thought and adjusting over and over again without baseline. The other is starting modeling by despising the key step of placing reference image which makes it not accurate. And it will cause ambiguity to choose which view. Either case will lead to faults and inefficiency.

3. The introduction to the methods of placing background image

In practice, the writer summarizes that the size and location of the modeling object must be consistent in the reference placed link. According to different requirements, taking proper methods of placing background image is the key to make these two right and efficient. The following three methods are easy-to-use.

3.1. Reference bitmap placed by box

Firstly, if images have exact explanation of sizes, we can build a suitable box. Secondly, the design drafts of the three views or multiple views are imported into the corresponding view window. The design drawings should be precisely cut first, convenient for adjustment later. And then adjust the drawing size and position to make it inscribed on the object in the three side of the box. After the alignment in turn, mark points in the object's key position and examine if it places accurately from different view windows. As shown in Fig 1.

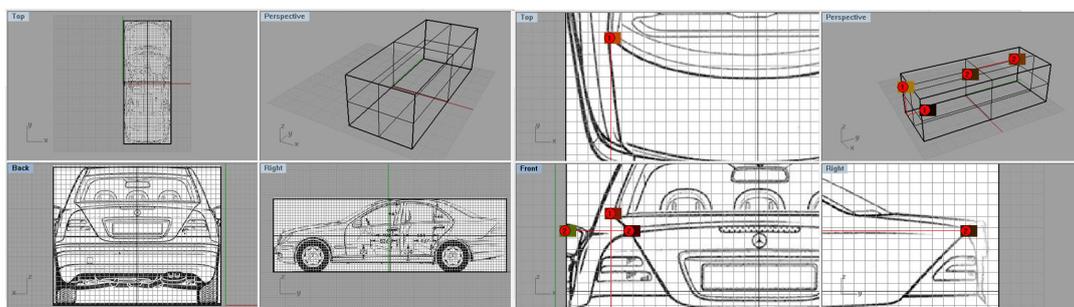


Figure 1. Reference bitmap placed by box.

If there are no sizes provided, we also need to cut the design drawings precisely first. And then lead into the view of reference bitmap and make its size such as length and width and position as a

benchmark. Put the corresponding references into the other views according to their length or width. Adjust to the same length or width and the height can be determined naturally good. Next, import other reference bitmaps according to the length, width and height. If it is supposed to be more intuitive, you can build another box after the last step. Finally, examine in the same way.

3.2. Reference bitmap placed by gridding

In product design, designers often need to start modeling from design draft. At this time, it is a problem in determining the size and location of the background images because the design draft may not be so precise. So, there are some experienced designers sketching on grid coordinate paper for later modeling. If there were no grids before, we can add grids to the draft and make the grids and the key points as a benchmark for placing and sampling. The density of grid determines the precision of the model. The greater the density, the higher precision it is. But, this will cut the efficiency of placing image and modeling. So, the density of grid should be determined by the precision needed.

Firstly, import an image to the top view using the main view draft for example. After it is adjusted to a proper size, we draw line A which is based on the grid coordinates with line tool as a reference datum line. Then, draw line B as the medial axis and import the corresponding draft into the front view. Adjust the size and position of the reference image benchmarked against line A. Next, adjust the length of line B in this view according to the draft so that you can ensure the consistency of the position and size. At last, finish adjusting the position and size of the side elevation according to these main lines. As shown in the figure 2, it is a convenient way to placing background image depending on grid and coordinate. Although the outline of the design draft does not fit the three views completely, the sampling and the later modeling won't be influenced.

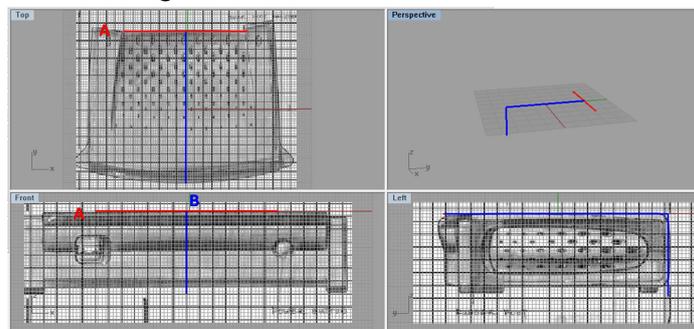


Figure 2. Reference bitmap placed by gridding.

3.3. Reference bitmap placed by photographing

In production practice, more product sample models create directly by using or referring to the product photo. So reference bitmap placed by photographing is the major means of 3D reconstruction. Effectively using of the photo image and getting useful data from it is an important way to develop new product and improve the existing products [9]. But the object which shows three-dimensional space by 2D images will be influenced by high, stadia and vision, focal length and many other factors and then have the deformation on perspective. Therefore, product's pictures of multiple angle of view are needed to be the reference of modeling. Besides, when you take a photo, not only should pay attention to minimizing the distortion deformation effects of perspective and light, but also pay attention to that the body contour and structure line should be clear. In addition, when you take a photo,

the object should not be too big or too small and the lens of your camera can't get too close to the object and cannot use wide Angle lens.

When we are taking photos, the selection of reference object have two cases to ensure the minimal perspective deformation of modeling object. First, if there are the regular form of modeling object, we can judge whether these regular form is close to the surface three view drawing according to the standard such as whether the circular deformation for elliptical, rectangular and deformation for the trapezium. Second, if it is the irregular form of modeling object itself, we need to choose relatively simple geometric shapes as a reference. The choice of reference substance is flexible so that we can use local materials. The basic principle is a simple shape and the size of the reference substance is appropriate for the modeling object. If the size of the reference object is relatively smaller, the error of modeling object is bigger. If the reference object is too big, it will also have the perspective error.

The specific method is shown in figure 3. Object modeling is irregular form. In this time, we use the regular form of object as a reference to take photos. After importing the photos of all angles of views, complete the adjustment of the size and location of the reference map in the background with the reference object. The size and location of the object modeling are naturally consistent in this way. Because the perspective distortion brought by deformation is inevitable, object modeling error is inevitable even if the form rule of reference position and size consistent. As shown in figure 3, the right end of the drawn curve in the top view is obviously longer than the modeling object in the front view. It is because of the foreshortening effects and it cannot be avoided. At this point, use various references flexibly and keep the perspective of error in mind and do not operate mechanically. At the same time, we are supposed to think about how to put reference in the different views. Neither it affects counterpoint, also does not produce deformation.

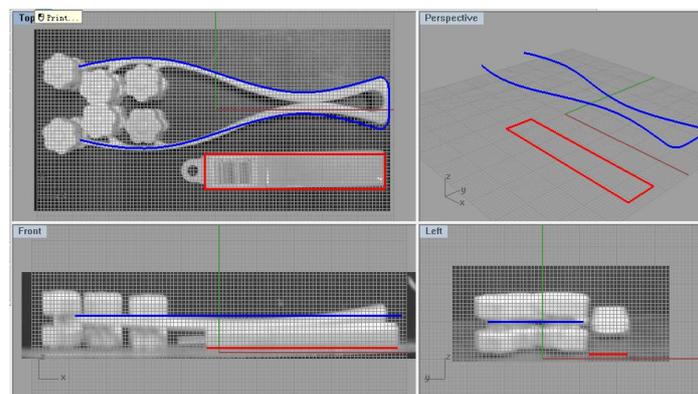


Figure 3. Reference bitmap placed by photographing.

4. The comparison and analysis of the three methods' characteristics

4.1. Reference bitmap placed by box

This method applies to the case which has accurate data and standard reference images. The characteristic of it is placing image fast and clearly. As a result of the quite high reference value of the reference bitmaps, the drawing requirement of this method is very high. The model is loyal to the drawings and it features high precision. And this method is always used for detailed modeling.

4.2. Reference bitmap placed by gridding

This method is mainly aimed at hand-drawn sketches with low accuracy and is suitable for the 3D performance of conceptual design. We should pay attention to selective reference when modeling as a result of the original drafts' low precision. The key outline and line form are which we general refer to. We can adjust the location of the Product's detail parts according to the actual situation of three views.

4.3. Reference bitmap placed by photographing

The biggest advantage of this method is to get the reference image fast. And it is suitable for modeling irregular objects form and modeling without drawings. In the process of taking photos, the effects of the perspective deformation should be reduced as far as possible. When we are making the details of model, photo reference value is not too high regardless of the form or location. It requires people to get a further understanding of the product itself.

These three methods have common ideas. Make sure of the size of the object modeling first and make full use of the grid view and fill the view as far as possible so that the error is relatively low. Then choose or draw the key line (point) flexibly as a benchmark to play an important role^[10]. At last, according to the specific situation, make an auxiliary reference line to examine if the location and the size of these two key elements are consistent. The analysis of the three is shown in table 1.

Table 1. The difference among the three methods.

| Method | Advantage | Disadvantage | Proper types of reference bitmap |
|--|---------------------------------|---|--|
| Reference bitmap placed by box | Place image fast and clearly | Need accurate and multiple views design drawings | Precise design drawings |
| Reference bitmap placed by gridding | Flexible, apply to a wide range | Increase the uncertainty because of the inaccurate drafts | Design drafts |
| Reference bitmap placed by photographing | Get the reference image fast | Limitation of object size, perspective error | the modeling object with varied form and complex shape |

5. Conclusion

Because of the large degrees of freedom of Rhino modeling, we need more reasonable planning and clear ideas. The logic thinking ability shows up as the preparing work (placing background images) before modeling. The above three methods have their own characteristics and the work for modeling provides a logical train of thinking. Only when you choose the proper methods can you model handily and do not be massy at first step. Following is the core of these three methods. Avoid form complex modeling object itself and make the drawn related reference line (or points) as the benchmark in order to make the background reference in all views are consistent with the size and location of the modeling objects. Although the reference image matters to the determination of the structure line of modeling in its infancy, the reference bitmap is only a reference role and we cannot rely too much on it.

Especially when using hand-painted sketch and entity pictures for reference, we need to process the details flexibly. The ability all we need to develop is to have an in-depth understanding of the form and have a well-thought-out plan.

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