



**Title:**

**Auto Stabilizer Bar Check Tool Automatic Design based on UG Secondary Development**

**Authors:**

Zheng Zhao, 17721057423@163.com, China Agricultural University  
 Min Zhou, zhoumin2016@cau.edu.cn, China Agricultural University

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**Introduction:**

With the development of digital industry, 3-D CAD (computer aided design) software has been widely used, but general 3-D CAD software can only solve most basic usage needs, cannot satisfy the specific needs of users.

As shown in Figure 1-1, the stabilizer bar is a part of the automobile suspension used to reduce the roll of the vehicle in turning and control the body attitude. In the structural design of the vehicle, the design of the stabilizer bar is at the end of the body design, the change of the body design scheme is likely to affect the design shape of the stabilizer bar, and final reflection to the stabilizer rod manufacturers' commercial inspection tool design changes.

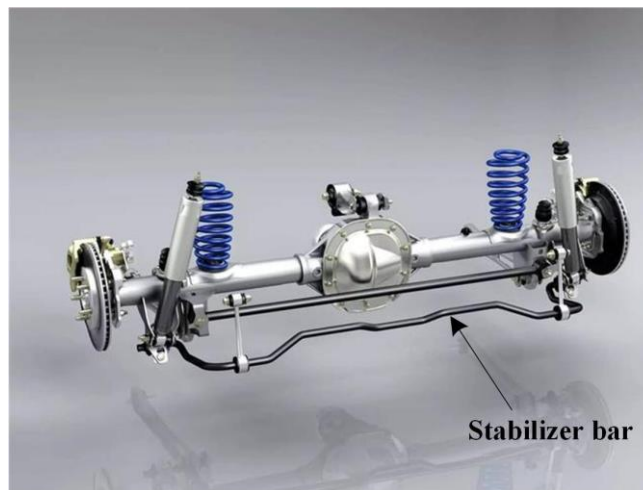


Fig. 1: Stabilizer bar.

Figure 2 shows the three-dimensional model of a certain type of stabilizer bar tester. The stabilizer bar tester is composed of a base, bottom plate, gage block, limit slider, end block, end pin and handle, among which the gage block and end block are the testing components of the stabilizer bar tester.

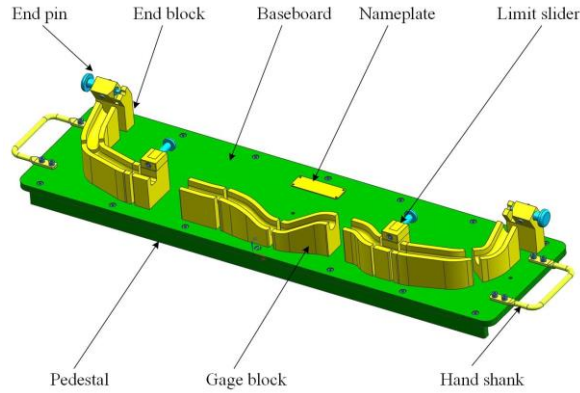


Fig. 2: A model of a stabilizer bar check.

In view of the automobile stabilizer bar manufacturers of the fixture design needs, secondary development for UG, to achieve the automatic design of the stabilizer bar fixture, so as to reduce the burden of designers, improve the design efficiency, and further enhance the enterprise digital design level and comprehensive competitiveness.

In the process of automatic design of stabilizer bar development, there are the following problems and difficulties:

(1) In UG, the center line of cylinder model can be extracted as shown in Figure 3 and Figure 4. The center line of cylindrical cylinder can be extracted, but the center line of non-cylindrical cylinder can't be obtained. There is no command to extract the center line of tube body with complicated shape in a single and complete way.

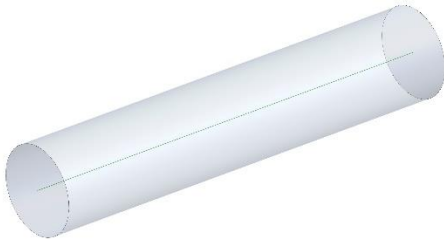


Fig. 3: Cylinder segment.

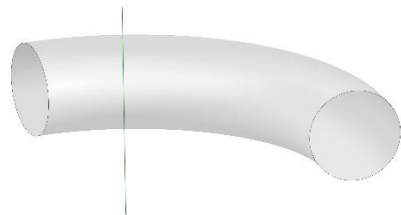


Fig. 4: Non-cylindrical segment.

The point cloud provides us with the idea of analyzing the model. Through the point cloud, 3D entities can be scanned into editable CAD models, thus providing convenience for accurate description [1]. And so on, Song et al. [2] proposed a range field-guided median method to extract one-dimensional curve skeleton from the point cloud model. After the point cloud voxelization, the initial skeleton of the model is extracted by multi-scale parameter thinning method from the range field of the point cloud. Yu et al. [3] proposed an improved grid skeleton extraction algorithm based on shrinkage. First, the model was virtual closed, and a single ring area sequence weighting scheme was proposed to calculate the displacement of skeleton node displacement to obtain a model skeleton with high accuracy. Feng et al. [4] proposed a skeleton extraction method based on Poisson equation, and defined three-dimensional model skeleton by extracting key points. He et al. [5] studied the skeleton extraction algorithm of point cloud contraction, constructed the transformation matrix by using the neighborhood, extracted the discrete point set approximate to the real skeleton by Laplace Contraction, and constructed the one-dimensional curve skeleton by using the weighted undirected graph and edge folding algorithm.

(2) Execute the sweeping program in UG. When the number of lines in the sketch is greater than or equal to 2, the result of sweeping molding will be affected by the order and direction of lines into the distorted entity as shown in Figure 5. The sweeping needs to make the sketch lines correspond one by one. And in the UG secondary development, cannot achieve the corresponding sketch lines.

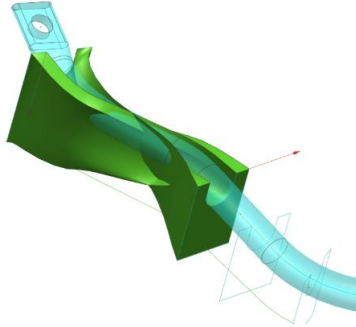


Fig. 5: Figure distortion caused by sweeping.

In order to realize the development of automatic design program of stabilizer bar check, the above problems are studied in this paper.

#### Stabilizer bar center line extraction method and sweep program implementation method

In view of the above stabilizer bar automatic design program development problems and difficulties, this paper carried on a deep study.

##### *Stabilizer bar center line extraction method*

In this paper, based on the internal lattice information of the stabilizer bar model, the points on the skeleton of the center line were extracted by calculating the corresponding center of the circle, and the center line of the stabilizer bar was obtained by curve fitting of all the centers of the circle.

Assume that there is A coordinate  $(x_1, y_1, z_1)$  of point A within the stabilizer bar body whose distance from the bar body surface is not equal to the radius of the bar body; the coordinate of point B, the closest distance from point A to the bar body surface, is  $(x_2, y_2, z_2)$ ; and the coordinate of the central point of the tube body section where points A and B are located is O  $(x_0, y_0, z_0)$ .

$$x_0 = x_2 - k(x_2 - x_1)$$

$$y_0 = y_2 - k(y_2 - y_1)$$

$$z_0 = z_2 - k(z_2 - z_1)$$

If there are enough points A along the axial direction inside the bar body model, the coordinates of the corresponding center point O can be calculated and the set of points O approaches the center line skeleton of the bar body, as shown in Figure 6. The figure shows a stabilizer bar model with a series of green dot features in the bar body, which are the calculated point skeleton of the center line of the bar body.

By curve fitting the point skeleton of the center line of the bar, the center line of the bar can be obtained.

##### *Sweep program implementation method*

In this paper, the development of the UG sweep program, the corresponding curve of the two sketches in the execution of the sweep, you can draw a piece model, in a certain order after the other corresponding curve of the two sketches of the sweep, in turn get the corresponding piece model. As shown in Figure 7, the sheet body ( I ) is first drawn with the above method, and then the sheet body ( II ) is drawn. The process is repeated to sweep all curves on the sketch. The resulting model is different from the actual entity structure obtained by scanning. The model is a monolithic structure, but its model frame is the same as the corresponding entity structure.

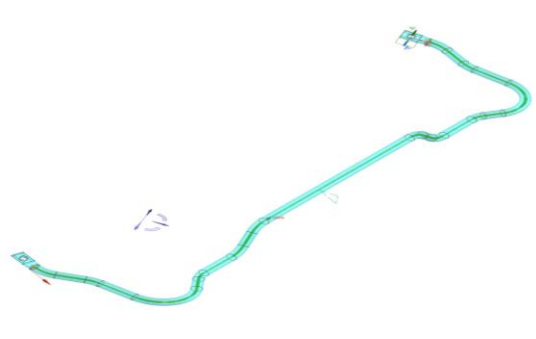


Fig. 6: Point skeleton of the center line of the stabilizer bar.

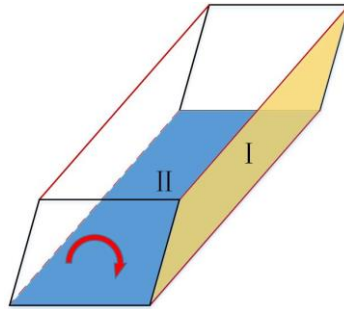


Fig. 7: Secondary development of sweep.

#### Related program development:

Based on the above methods, related programs are developed

##### *Stabilizer bar center line take procedure*

Based on the extraction method of the center line of the stabilizer bar, the program is designed. The actual method of the program is shown in Figure 8.

Based on UG API, read the information of the surrounding box of the rod body, create points inside the surrounding box based on the information of the surrounding box, calculate the distance between the created points and the model of the rod body, extract the points inside the rod body but not zero to the surface of the rod body, traverse the extracted point is point A, calculate the distance between point A and the surface of the rod body, extract the nearest point is point B. Calculate the corresponding coordinates of O from the coordinates of points A and B. By traversing all the internal points of the bar body to calculate the coordinates of O, the skeleton of the center line points of the bar body can be obtained.

The program of fitting the point skeleton into curves was designed by UG Open, and the center line of the point skeleton could be obtained by curve fitting, as shown in Figure 9. According to the point skeleton of the center line of the rod body shown in Figure 6, the points were fitted to obtain the fitting curve shown in the local area.

##### *Stabilizer bar check block sweep procedure*

Furthermore, based on the sweeping method proposed above, the sweeping program of the stabilizer bar gage block is developed.

Figure 10 shows the schematic diagram of the sweeping program executed in UG. Sketch 1 and sketch 2 are two sketches, and the guide line is the track line of the sweep. The lines in the two sketches need to correspond. Sketch 1 and sketch 2 are the shape outline of the model section obtained by scanning, that is, the black solid line in the figure shows the outline, the blue solid line is the guide line, which is the guide line of the scanning direction, and the red dotted line is the boundary of the model scanning direction, whose shape is determined by the guide line. Sketch 1 and sketch 2

consist of an equal number of lines respectively, and the lines of the two sketches need to correspond during the sweep process.

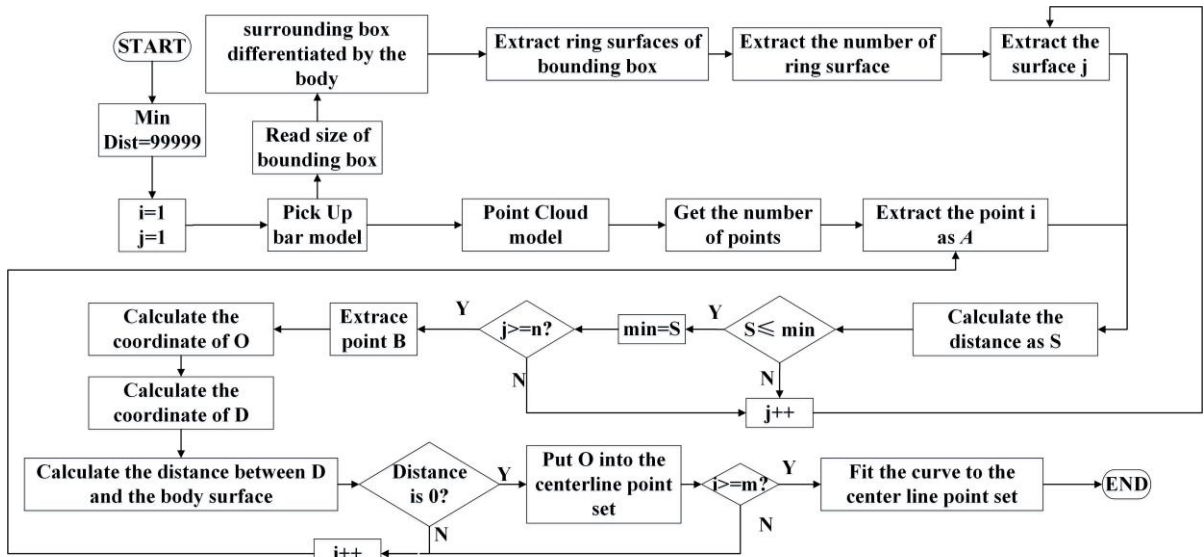


Fig. 8: Process for extracting the centerline skeleton.

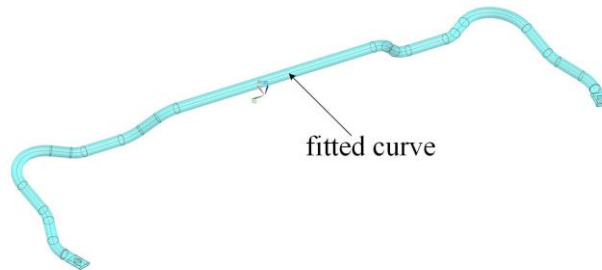


Fig. 9: Fitting center line of the bar body.

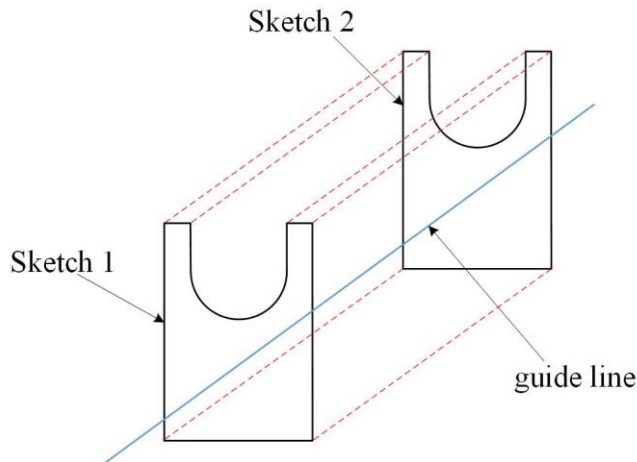


Fig. 10: Sweeping in UG.

There are special functions in the UG API for the execution of the sweep program, its input includes the sweep guide line and sweep curve. The lines with the same number in the two sketches are respectively taken as the sweeping lines, and the guide line is taken as the track line to sweep. The process is traversed to realize the sweeping of all the lines of the sketch. Figure 11 shows the scanning result, the frame of the model is the same as that of the hand-drawn model.

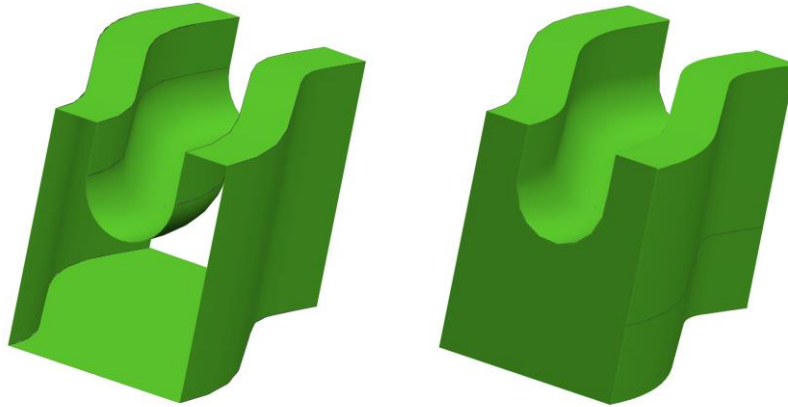


Fig. 11: Left: The result of the method sweep in this paper; Right: Manual sweep result.

#### Conclusion:

Stabilizer bar tester is an important inspection component in stabilizer bar production. In this paper, the shortcomings and difficulties in the process of automatic design and development of the stabilizer bar check are put forward corresponding solutions, and targeted program development, so that UG can effectively and accurately extract the center line of the bar body and draw the check block model. The program greatly improves the design efficiency.

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