

# Sketch-based 3D model design

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## 1. Abstract

Our final project is focus on the sketch-based 3D model design. Comparing to the traditional mathematics-based model design, the sketch-based approach is more time efficient and easy to learn. Our system is based on Teddy, which is a successful 3D model design system. We implement two major operations in Teddy, creating and cutting. We also support two additional operations, adding multiple objects and scaling by different orientations.

## 2. Operations

Our interface is based on the debugging interface of project 2(Ray tracing). The details of all the operations are as follows.

### 2.1 Creating Object

To create an object, press the left button of mouse and drag. The new 3D model will be shown in the window. Figure 1 shows an example of creating. We use the same procedure as Teddy to create object, including 2D Constrained Delaunay triangulation, chordal axis extraction, elevation estimation and ellipse regression.

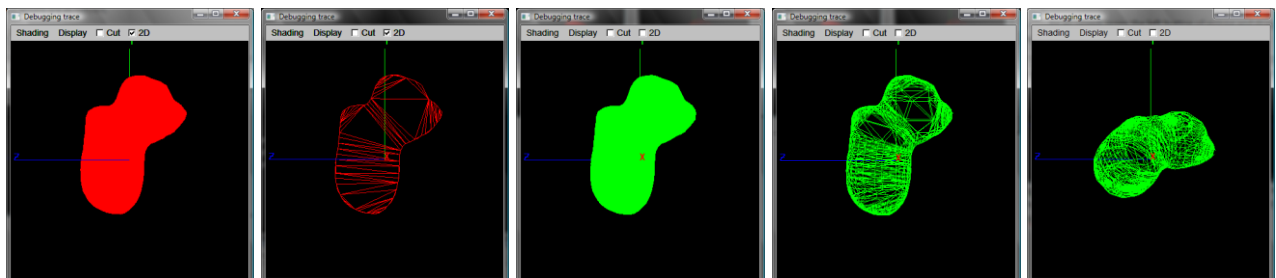


Figure 1. Example of creating operation. The left one is the region that user draws; the middle left one is the 2D Constrained Delaunay triangulation; the middle one is the 3D model; the middle right one is the trimesh of the 3D model; the right one is the rotated 3D model.

### 2.2 Adding Multiple Object

Unlike Teddy, we support multiple objects. This is actually another way to implement extrusion operations. Figure 2 shows an example of this operation.

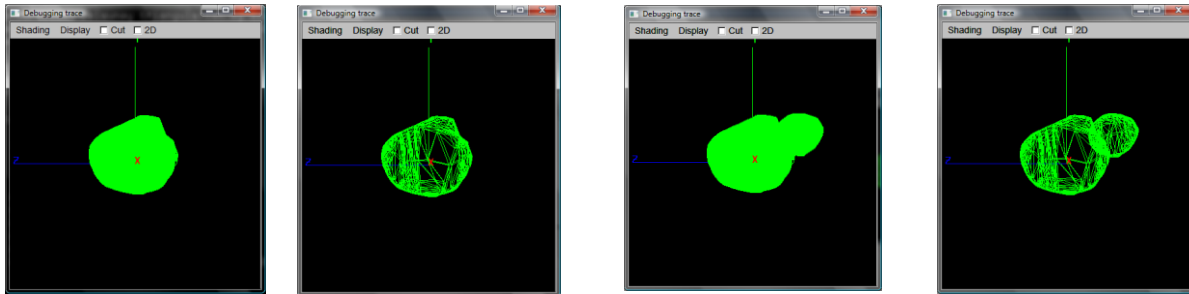


Figure 2. Example of adding multiple objects (extrusion). The left one is the original object; the left middle one is the trimesh of the 3D model; the right middle one is created by adding another object; the right one is the trimesh of both models.

### 2.3 Rotation

Rotation is very useful since we need to design the 3D model in the 2D interface. To rotate, press the right button of the mouse and drag. Figure 3 shows an example of rotation.



Figure 3. Example of Rotation. The left one is the original object; the right one is the rotated model.

### 2.4 Scaling by multiple orientations

Since the elevation of the 3D model is calculated automatically, the model does not always meet the user's requirement. We implement the creative scaling operations to allow user adjust the model. To adjust the scale, press the middle button of the mouse and move mouse to different direction. Moving to the left and right directions can change the horizontal axis of object, while moving forward and backward can change the vertical axis of object. Figure 4 shows an example. Note that by combining rotation and scaling, we can scale the model to any orientation.

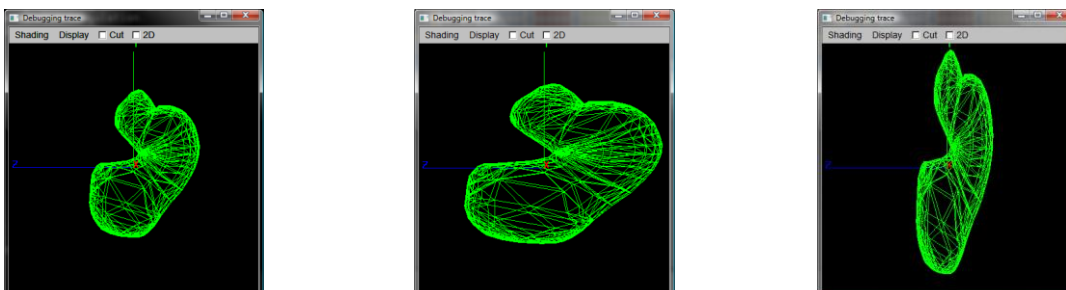


Figure 4. Example of scaling operation. The left one is the original object; the middle one is scaling horizontally; the right one is scaling vertically.

## 2.5 Cutting

To cut the model, check the “cut” option at the top of the window, then draw a line across the model by dragging the mouse with left mouse button pressed. After that, click the left mouse button to indicate which part of the object you want. The details of cutting operation are as follows. First get a mask image, based on the cutting line, to indicate which part of the object the user wants. Second remove the triangles out of the mask image, and refine the triangles on the boundaries. Third add a new trimesh at the cutting plane. Figure 5 shows an example of this operation. The cutting operation is very difficult to implement. There are a lot of issues with this operation, especially adding the cutting plane. We will fix these bugs later.

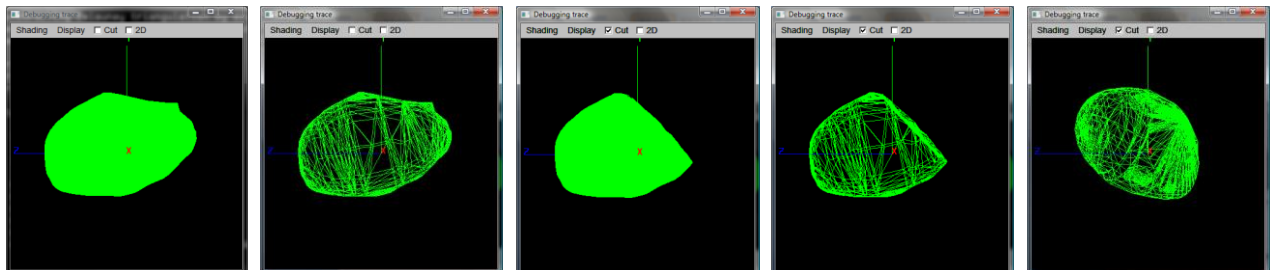


Figure 5. Example of cutting. The left one is the original model; the middle left one is the trimesh; the middle one is the model after cut; the middle right one is the trimesh of the cut model; the right one is the cut model with rotation.

## 3. Conclusion and Future Work

We implement a sketch-based 3D model design system in this project. This is the first step of our sketch-based 3D model design. The results so far are promising. However, there are a lot of difficulties to deal with the trimesh... We have many bugs in the code need to be fixed... We will improve it later.

For future work, we want to extend it to image-based 3D model design. Actually our system is capable to do the image-based design. We can use the scaling and rotation to allow the 3D model cover the image segmentation. Then use the cutting operation to fit the 3D model to image segmentation. However we do not have the image processing part so far, so we have to leave this promising work in the future.