Chapter 15: Penguin - Point Editing and Blending

This tutorial demonstrates point-editing techniques including moving and scaling control points and adding knots to surfaces to increase control. In addition, you will use blends to create smooth transitions between surfaces.

You will learn how to:

- Rebuild surfaces to add additional control points.
- Insert knots in a surface to add control points in a specific location.
- Edit surface control points to define a shape.
- Scale control points to change the object shape.
- Use object snaps projected to the construction plane.
- Orient an object on a surface.
- Create smooth blends between surfaces.

The body

If you like, open the example model, Penguin.3dm, and try to match the shapes as you are building the model. Experiment with your own shapes, too.

The body and head are created from one sphere. The shape is formed by moving the control points in the sphere to create the head.
**Draw a sphere**
- In the **Top** viewport, use the **Sphere** command to draw a sphere with a radius of **10** units.

**Rebuild the sphere**
- Use the **Rebuild** command to add more control points to the sphere.
  - In the **Rebuild Surface** dialog box, set the **Point count** in the **U** and **V** directions to **8** and the **Degree** in the **U** and **V** directions to **3**.
  - Check **Delete input**.
  - Click **OK**.
**Turn control points on**

- Use the **PointsOn (F10)** command to turn on the sphere’s control points. Look in all the viewports at the structure of the control points. The next step will change this structure so the influence of moving the control points does not extend over the whole sphere.

**Insert knots**

- Use the **InsertKnot** command to insert two knots in the sphere in the area where you want the neck. Insert the knots in the u-direction only as illustrated.
Examine the control point structure after inserting the knot.

Reposition control points to create the indentation for the neck and to reform the body shape.

**Flatten the bottom**

1. In the **Front** viewport, select all the control points in the lowest rows of the sphere.

2. Use the **SetPt** command to match them to the bottom pole point in the world z-direction only.

   2. In the **Set Points** dialog box, check **Set Z**, clear the **Set X** and **Set Y** check boxes, and click **World**.
3. Drag the selected control points up.

This will align all of the selected control points to the same z-value (up in **Front** viewport), flattening the surface.
Drag points

- **Select** rows of control points with a window and drag them up or down in the **Front** viewport to shape the body.

Use **WireFrame** display mode if you find it easier to select control points in wireframe views.

Scale points

1. **Select** rows of control points with a window in the **Front** viewport.
2. In the **Top** viewport, use the **Scale2D** command to move them closer or farther away from the central point.
To pick the base point for the **Scale2D** command use the **Point** object snap with **Project** turned on. This will scale the points parallel to the construction plane. Watch the **Front** viewport to see the changes in the body shape as you move the control points closer to and farther from the center.

Experiment with the **Project** setting in the **Osnap** toolbar to see how it works. You will be able to see the tracking line projected to the construction plane in the viewports. Match the example model or use your own shape.
3. Drag individual groups of control points to make the body slightly flatter in the front near the neck as illustrated.

The eyes

The eye is an ellipsoid shape that is oriented onto the surface.

Create the eye

1. In the Top viewport, start the Ellipsoid command. Place the center point anywhere.
2. At the End of first axis prompt, type 1.1 to constrain the distance from the center point to the end of the axis to 1.1 units. Drag the cursor to the right and pick.
3. At the End of second axis prompt, type **1.1** to constrain the distance. Using these constraints has created a circular ellipsoid when seen from the top. Drag the cursor up or down in the Top viewport and pick.

![Diagram](image)

4. At the End of third axis prompt, type **.5**, press Enter.

![Diagram](image)

**Orient the eye on the surface**

1. **Select** the eye ellipsoid in the Top or Perspective viewport.
2. Start the **OrientOnSrf** command.
3. At the Base point... prompt, in the Top viewport, pick the center of the ellipsoid.

4. At the Reference point for scaling and rotation prompt, pick any point to the right or left of the eye ellipsoid.
   The exact location is not important.

5. At the Surface to orient on prompt, select the penguin body/head.

6. In the Orient on Surface dialog box, click OK.
7. At the **Point on surface to orient to...** prompt, move the cursor onto the head to where you want to place the eye and click.

![Image of eye placement](image)

**Mirror the eye**
- Use the **Mirror** command in the **Front** viewport to create the second eye.

![Image of mirror command](image)

**The beak**

The beak is another ellipsoid that you can edit to change the shape.

**Create the basic beak shape**
1. In the **Top** viewport, start the **Ellipsoid** command.
   Place the center point anywhere.
2. At the **End of first axis** prompt, type **3** to constrain the distance from the center point to the end of the axis to three units.
   Drag the cursor to the right and pick.

3. At the **End of second axis** prompt, type **2** to constrain the distance.
   Using these constraints creates a circular ellipsoid when seen from the top.
   Drag the cursor up or down in the **Top** viewport and pick.
4. At the **End of third axis** prompt, type **1**, press **Enter**.

**Shape the beak**

1. Turn on the beak's **control points (F10)**.
   - In the **Front** viewport, select the lower row of points and drag them up.
2. **Select** the row of points in the top center and drag them down to shape the beak. Try using the **Nudge** keys (Alt + Arrow direction keys) to nudge the selected points.

**Move the beak**

- **Move** the beak into position.

**The feet**

The feet are created using another ellipsoid. Knots are added to help create the webbed toes.

**Draw the beginning ellipsoid**

1. In the **Front** viewport, start the **Ellipsoid** command. Place the center point anywhere.
2. At the **End of first axis** prompt, type 1 to constrain the distance from the center point to the end of the axis to one unit.
   Drag the cursor up and pick.

3. At the **End of second axis** prompt, type 3 to constrain the distance.
   In the **Top** viewport, drag the cursor up and pick.

4. At the **End of third axis** prompt, type 3, press **Enter**.
Rebuild the ellipsoid

- Use the **Rebuild** command to add more control points to the ellipsoid.
  - In the **Rebuild Surface** dialog box, set the **Point count** in the **U** and **V** directions to **8** and the **Degree** in the **U** and **V** directions to **3**.
  - Check **Delete input**.

Insert knots to create the webbed feet

- Use the **InsertKnot** command to insert four knots in the ellipsoid as illustrated.

Set the **Symmetrical=On**.
  - Insert the knots in the **V-direction**.
Scale the points from the center

1. **Select** control points as illustrated.

Use window and crossing selections to select the control points on both the top and bottom of the ellipsoid.
2. Use the **Scale2D** command to scale the control points out from the center of the foot. Use the **Point** object snap to set the base point of the scale to the center point of the ellipsoid. Drag the points to make the whole foot about twice the size of the original ellipsoid.

Use the **Move** command to move the foot under the penguin body.

Use the **Rotate** command to rotate the foot out slightly.
Mirror the foot

- Use the **Mirror** command to create the second foot.

Create a cutting plane

1. Select the feet.
2. In the Front viewport, use the **CutPlane** command to make a planar surface that passes through the feet as illustrated.
The `CutPlane` command makes a plane that passes through the selected surfaces along the line you draw.

Trim and Join the feet and the plane

1. **Trim** the bottoms of the feet off with the plane as the cutting object.
2. Trim the excess plane from outside the feet.
3. **Join** the plane parts and the feet.
The tail

The tail is another ellipsoid. It is joined to the body with a smooth blend surface.

Create the tail shape

- Draw an Ellipsoid that is 4 units long, 3 units wide (Top viewport), and 1.5 units tall (Front viewport).

Position the tail

- Move and Rotate the tail in position.

Union the tail and body

- Use the BooleanUnion command to trim and join the tail and the body shapes.
  The transition between the tail and body is rather abrupt; so replace this with a smooth blend surface.
  To do this, you must first create a gap between the two parts for the blend surface to fill.
Pipe the intersection

- Use the **Pipe** command to create a circular surface around the edge between the body and tail. At the **Select curve to create pipe around** prompt, select the edge between the tail and the body. At the **Radius for closed pipe** prompt, type .4.

![Pipe example image](image)

Trim the body and tail with the pipe

1. Use the **Trim** command to trim both the body and the tail surfaces inside the pipe.
2. At the **Select cutting objects** prompt, select the pipe, and press **Enter**.

![Trim example image](image)

3. At the **Select object to trim** prompt, select the body/tail, and press **Enter**.

**Tip:** Pick on the isocurve or edge that you can see inside the pipe.
Tip: With the `SetObjectDisplayMode` command, set the pipe to a wireframe or ghosted display mode so you can see the edge between the body and the tail. If you select the wrong part, undo within the `Trim` command and try again.
Blend between the tail and body

- Use the **BlendSrf** command to create a smooth surface between the tail and the body.

Join the body and tail

- **Join** the blend and tail to the body

The wings

Create the base wing shape

- Draw an **Ellipsoid** that is 2 units long, 2 units wide (**Top** viewport), and 6.5 units tall (**Front** viewport).

Rebuild the wing

1. Use the **Rebuild** command to add more control points to the ellipsoid.
   - In the **Rebuild Surface** dialog box, set the **Point count** in the **U** and **V** directions to 8 and the **Degree** in the **U** and **V** directions to 3.
   - Check **Delete input**.
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2. Drag control points to create the shape.

Bend the wing to the body

1. Use the **Bend** command in the **Front** viewport to bend the top of the wing shape toward the body. At the **Start of spine** prompt, in the **Front** viewport, pick near the bottom of the wing. At the **End of spine** prompt, pick near the top of the wing.
At the **Point to bend through**... prompt, drag the top of the wing toward the body.

2. If further positioning is needed, use the **Rotate** and **Move** commands to place the wing.

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**Mirror to the other side**

- Use the **Mirror** command to create the opposite wing.
**Boolean Union the wings and the body**
- To trim the wing holes and the wing, select both wings and the body and use the **BooleanUnion** command.

**Pipe the intersection**
- Use the **Pipe** command to create a circular surface around the edge between the body and each wing.
  
  At the **Select curve to create pipe around** prompt, select the edge of the hole in the body or the edge of the wing surface.
  
  At the **Radius for closed pipe** prompt, use a radius of about .6.

**Trim the body and wing**
1. Use the **Trim** command to trim the body and wing surfaces inside the pipe surfaces.
2. **Delete** the pipe surfaces.
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**Blend between the body and wings**
- Use the **BlendSrf** command to create a smooth surface between each wing and the body.

**Join the body and wings**
- **Join** the blends and wings to the body

**Finishing touches**
To finish the penguin, split the front part of the body so a different material can be applied to it.

**Draw a trim curve**
- In the **Right** viewport, draw a **Curve** from the beak down to the bottom as illustrated.
Split the body with the curve

- Use the **Split** command to split the body surface with the curve.

This allows a different color for the front of the body.

Join the body parts

- Use the **Join** command to join the body (except the front), the tail, and the wings.

Render

Rendering creates a realistic picture of your model with colors you assign. These render colors are different from the layer colors you might be using, which control the display in wireframe and shaded modes.

Set up the view

- Use the **Rendered** display mode to set the viewport rendered mode.

Assign materials

1. **Select** the body.
2. Start the **Properties** command.
3. In the **Properties** window, click the **Material** button.
4. Set **Assign material by**, to **Object**.
5. Under **Basic Settings**, click the **Color** swatch.
6. In the **Select Color** dialog box, select a color for the body.
7. Set the **Gloss finish** to about **40**.
8. **Select** the other parts and apply materials in the same way.