Organic Modeling with T-Splines and Rhino® 4

A tutorial in organic character creation

Ricardo Amaral,
Modellistica

Introduction

Paraglobal is a Portuguese mold making, plastic design and engineering company. One of Paraglobal's main areas of expertise is the design and manufacturing of highly organic products for automotive components, toys, and other uses.

In an industry that has traditionally been dominated by hand sculpting, Paraglobal is increasingly incorporating digital tools into its production process. There are a number of benefits from using digital models: it's easier to archive data, share data with clients, and explore design alternatives.

The problem

But Paraglobal has struggled to find a 3D package that can accurately make their organic models in a format that can be manufactured into a mold, at a price they can afford. Paraglobal considered several established industrial design packages, but the hefty pricetag (many thousands of dollars) made this impractical.

The solution: T-Splines

Then Paraglobal discovered a new solution, based on the familiar Rhinoceros® software the company has relied on for years: T-Splines for Rhino. T-Splines can easily handle organic objects, and gives the designer optimal levels of control in each area of the surface. The entire surface stays smooth, and is immediately ready for manufacturing.

The process

The following tutorial came out of collaboration from Sérgio Silva at Paraglobal and Ricardo Amaral at Modellistica and shows how to use T-Splines for organic shape creation. This cow is part of a set of didactic toy animals that Paraglobal is currently developing for children.
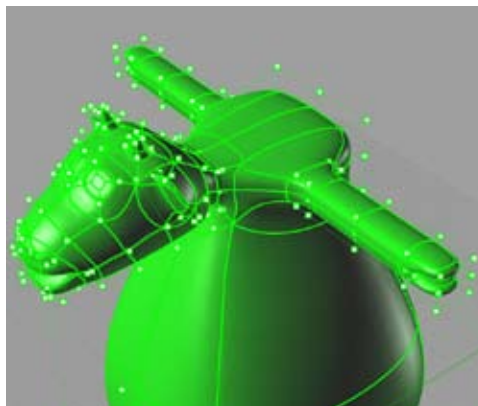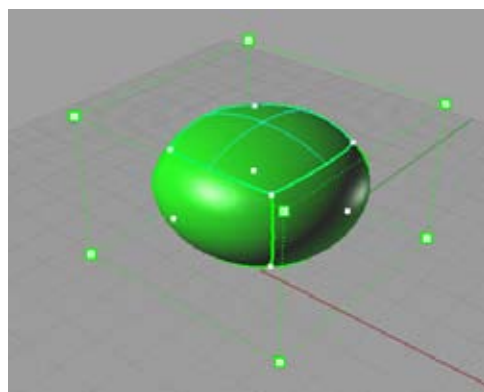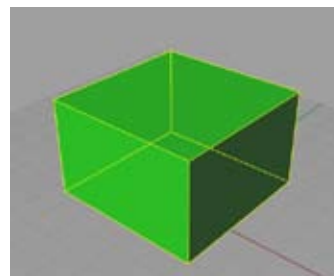
T•Splines

1 Body

Overview: The cow body will be created by performing a series of extrusions on the T-Splines surface. Introduced into Rhino by T-Splines, extrusions are an easy way to add new geometry to your existing model while maintaning smoothness. The body will be sculpted by using the T-Splines manipulators to scale and rotate.
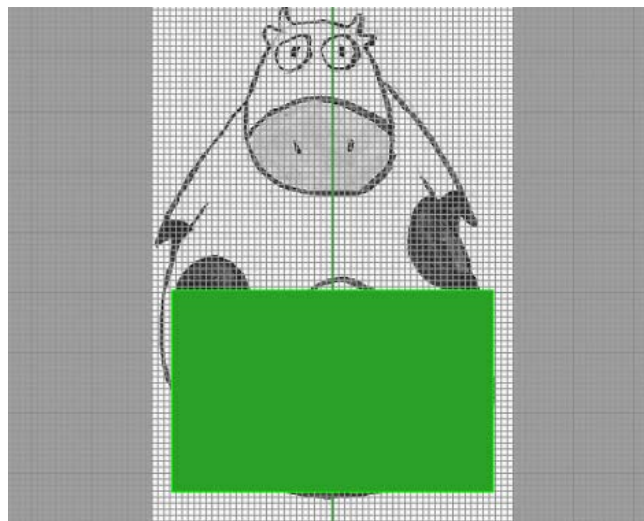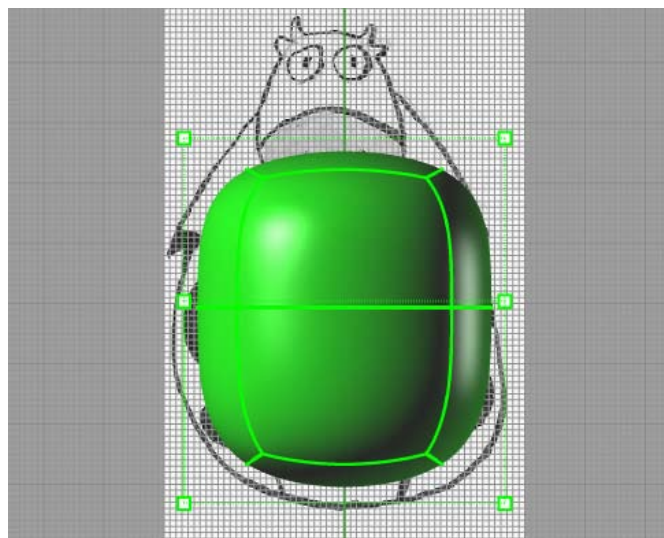

Start by creating a mesh box with 1 X 1 X 1 faces.

Convert the box to T-Splines using the tsConvert command. Turn on control points.
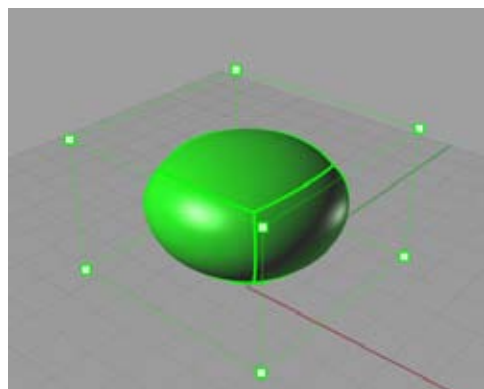
Now run the tsExtrude command and select the top face with the left mouse button, then hit enter to begin extruding. Select the perVertexNormal option.

T•Splines

Pull the extrusion vector up to the height shown here. With the perVertexNormal option enabled, it will only move in the world Z direction in this case.

Select the top four control points of the shape and run the tsManip command. It will give you 3 modes: translate, rotate and scale. We will use scale now. By CTRL + dragging the blue channel (world Z) you will be able to scale X & Y at the same time. Do so as indicated.
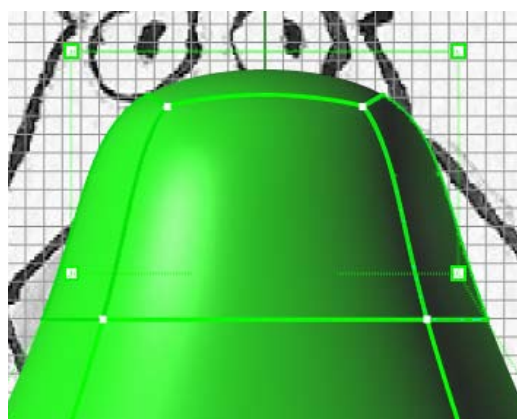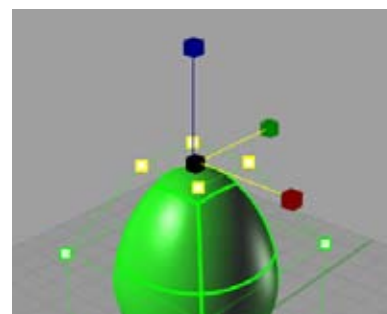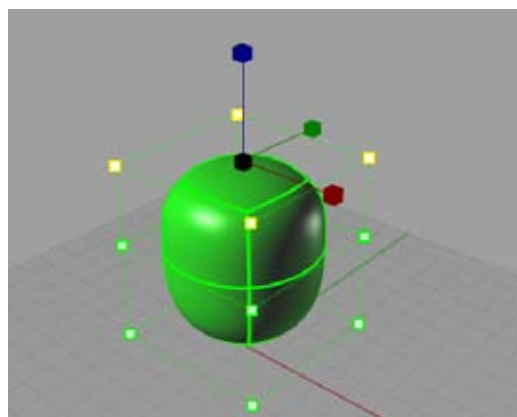

Go back to the tsExtrude command, now choose the Normal option and extrude the top face once more, like indicated.

T•Splines

2 Arms

Overview: To make the arms, we will continue to extrude and scale the T-Splines surface.

Go back to the tsExtrude command once more. We will now extrude two independent faces at once. Enter the tsExtrude command and click on each face as indicated, then hit ENTER. Select the per-VertexNormal option. When you move the mouse you will notice that each face extrudes the same distance, relative to its base. Extrude the faces by a small amount as indicated.
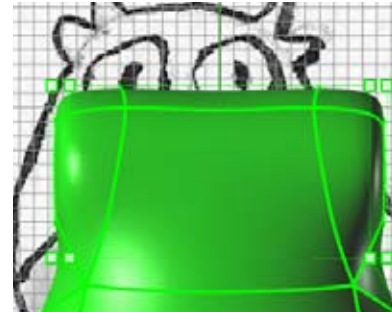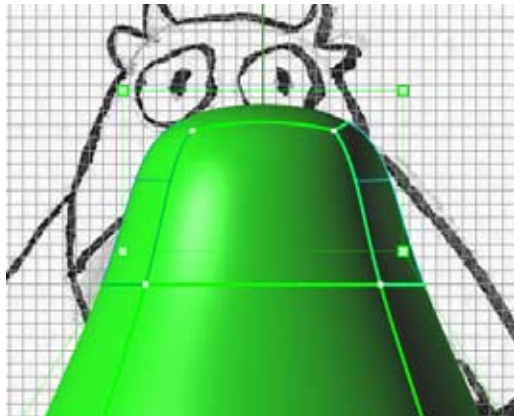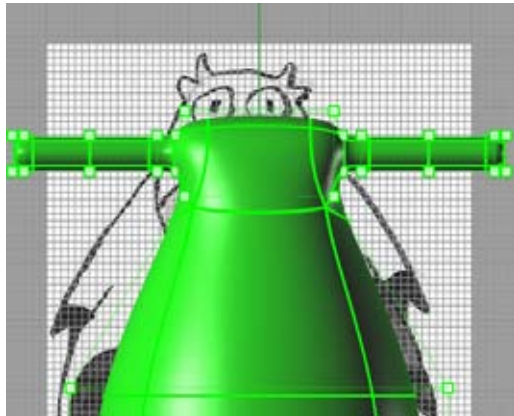

Now select the outside control points of each extruded face. Enter the tsManip command in the scale mode. CTRL drag the red (world X) to scale the control points in both Y & Z.
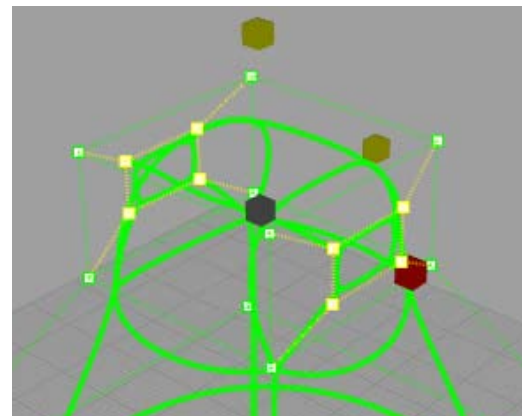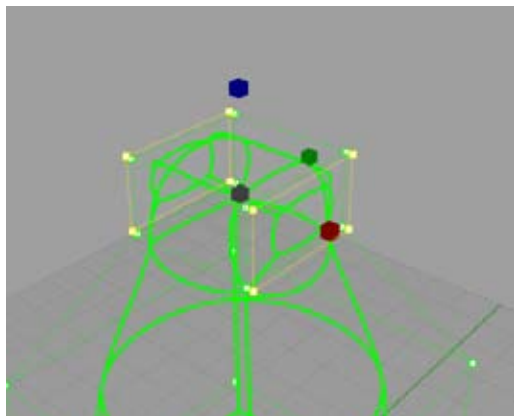
Run the tsExtrude Command and select the two opposite faces. Choose the perVertexNormal option again.

T•Splines
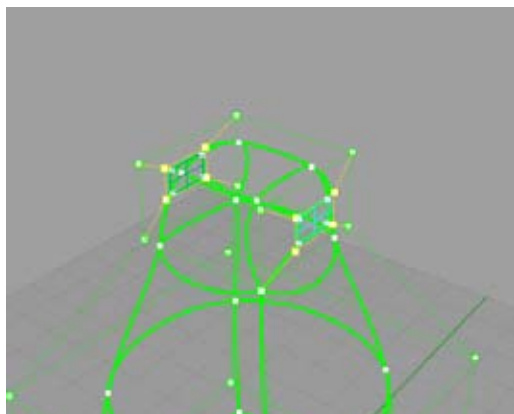
Do four more symmetrical extrusions like those shown in this image.

3 Head

Overview: While continuing to extrude, rotate, and scale the geometry, we will also add more detail to the surface to lay out the foundation of the eyes, nose, and mouth. We will use the special T-Splines Insert Point command to keep the detail localized to just the portion of the surface where we need it.
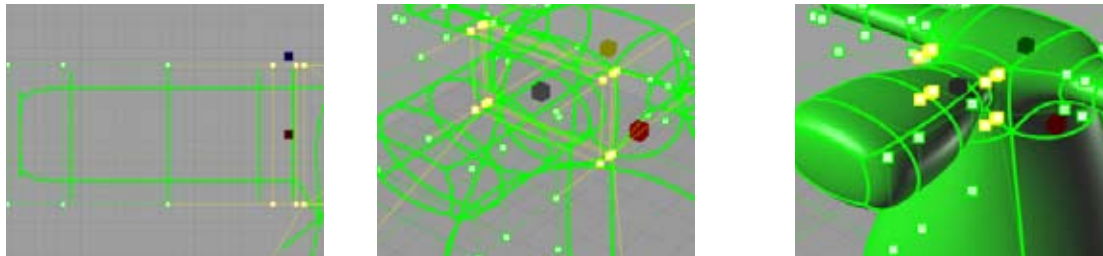
Extrude the front/top face by a small amount as indicated in the pictures.
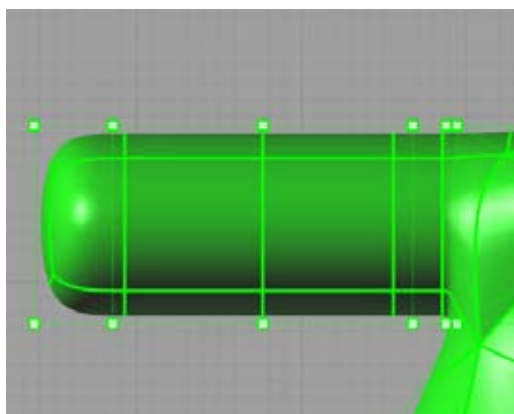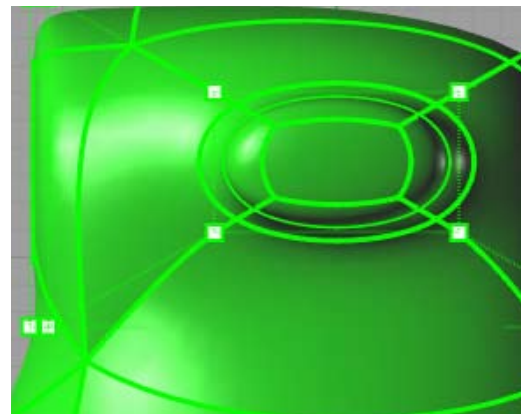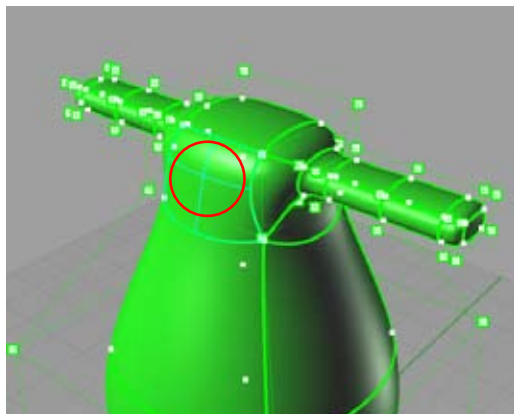
Extrude that same front face another four times.

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Now select the three indicated rows of control points and run the tsManip command in scale mode. CTRL drag the green (world Y) channel to scale the points down in both X & Z.

Select the three foremost rows of control points and run the tsManip command in scale mode again. CTRL drag the green (world Y) channel to scale the points up in both X & Z.
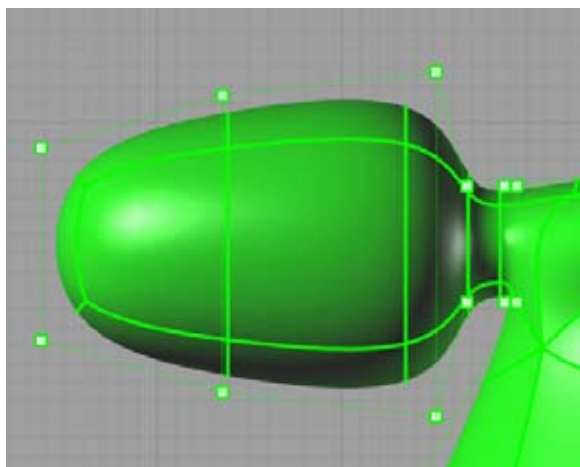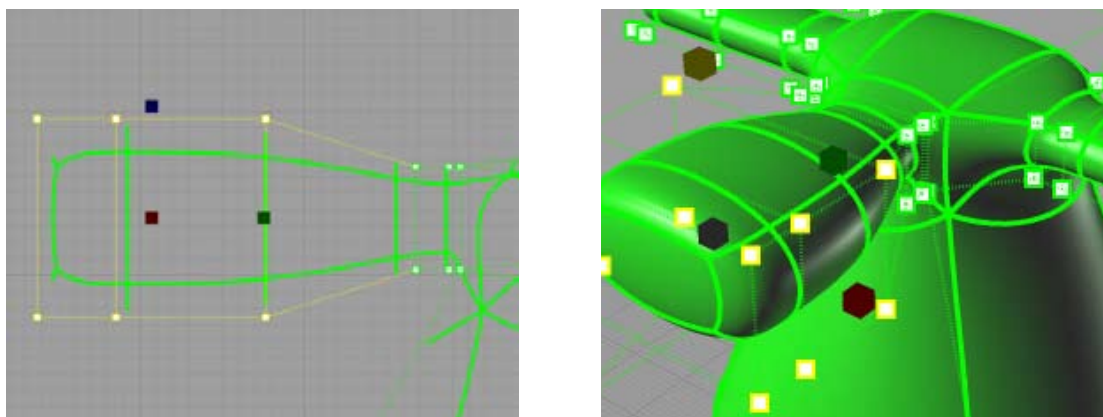

Play a bit more with tsManip with each individual row of control points to get this egg-shaped look.

T•Splines
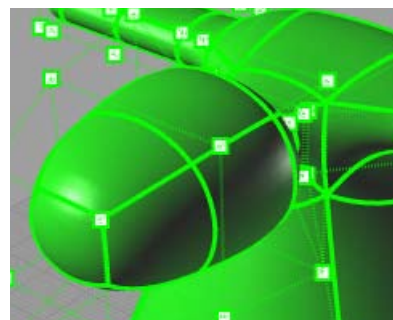
Select again the three foremost rows of control points. Using tsManip again, go into rotate mode. Click on the pivot option in the command line and place it somewhere around the yellow dot in this image. Rotate the points a little to the left then enter into translate mode and move them up a bit, to get something like this.
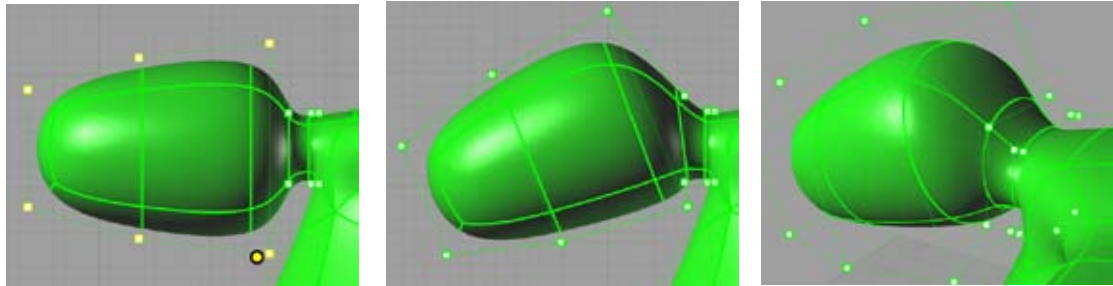
Now run tsInsertPoint and choose the InsertionType=Exact option. Then click in the middle of the isocurve as shown.
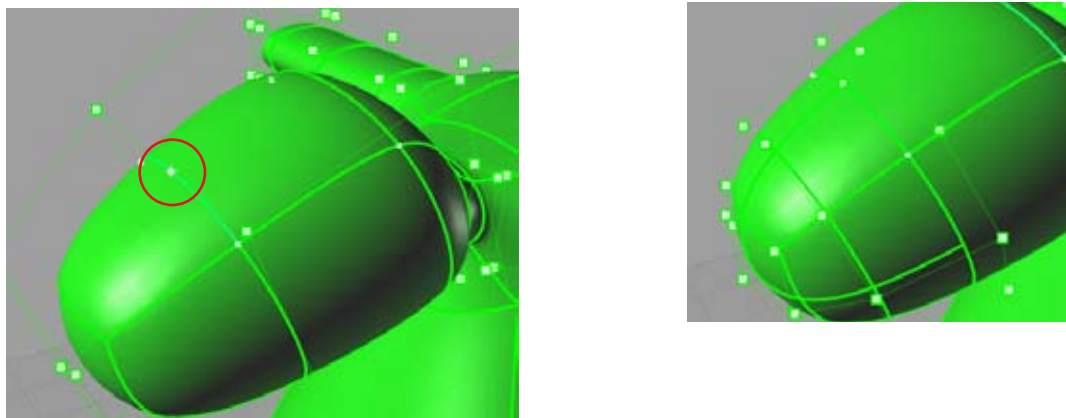
Extend each of the four new partial isoparms created (two circled below) along the top, bottom, left and right faces by using the tsExtendIsocurve command and clicking on each of the control points where you want to extend the isoparm.

T•Splines
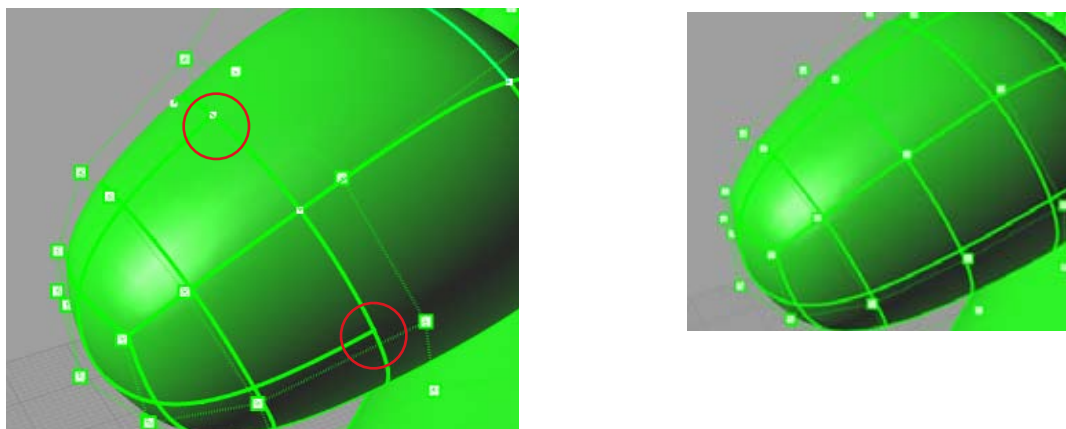
4 Horns

Overview: The next two body parts, the horns and the ears, will be made by extruding and scaling.
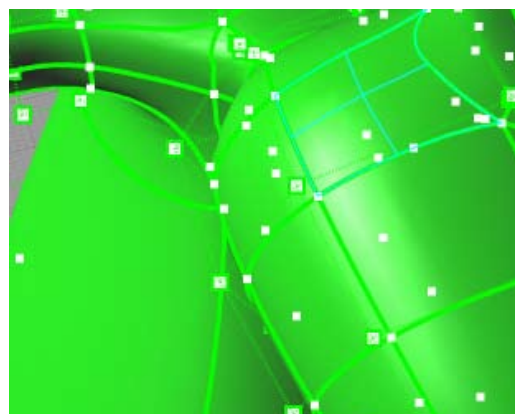
Extrude the indicated face, with perVertexNormal option, by a small amount.
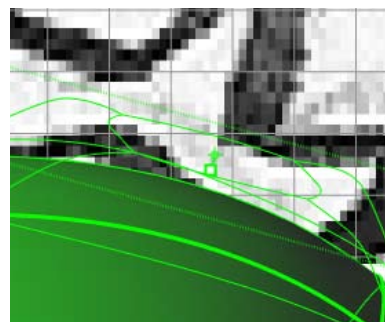
Select the four newly created control points from the extrusion and run the tsManip command in the scale mode. Drag the central box to scale down all thee axes at the same time as shown.
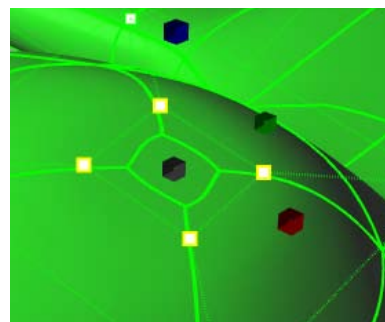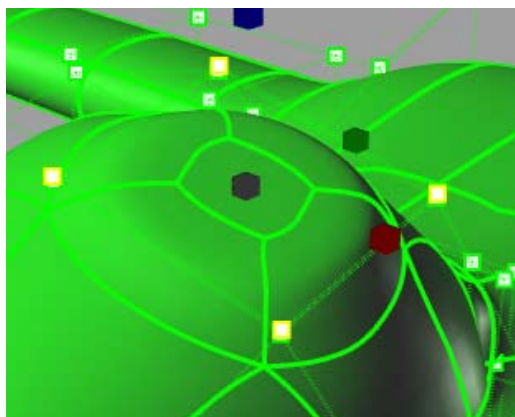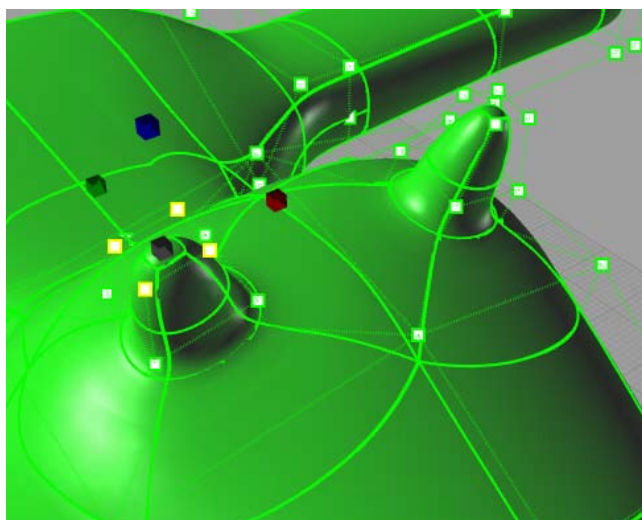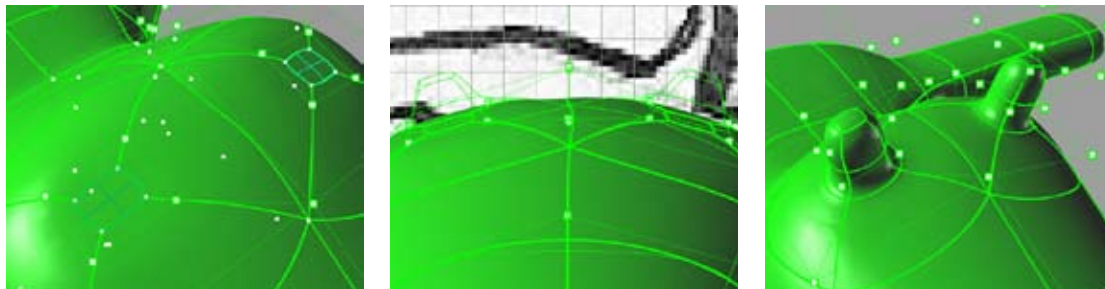

Repeat the same steps on the other side.

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Now enter the tsExtrude command with the perVertexNormal option again. Select the two new faces and extrude them twice.

With the tsManip command, scale down the four top control points of each horn in all three direction by clicking and dragging the middle box.
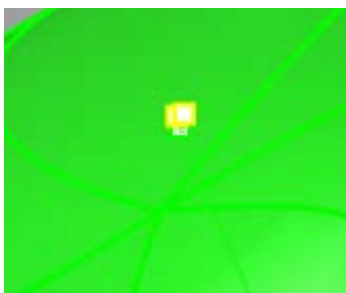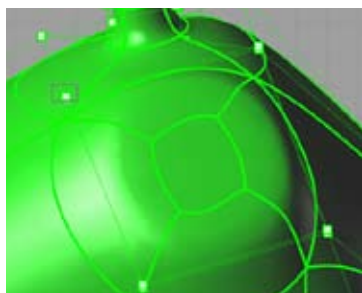
T•Splines

5 Ears

Use tsExtrude with perVertexNormal to create the base for the two ears like in the picture below. Extrude by a small amount.
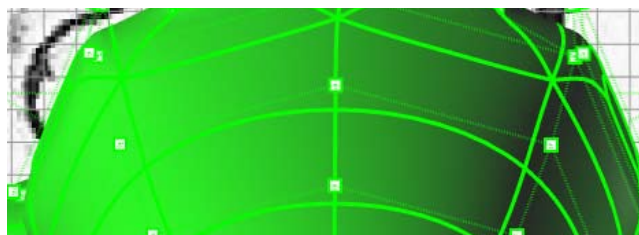
In a side view, select each new pair of symmetrical control points from each side and move them closer along the horizontal lines in the control polygon.

Run the tsExtrude command and select the two opposite faces defining the ear base. Extrude them by the amount shown below.
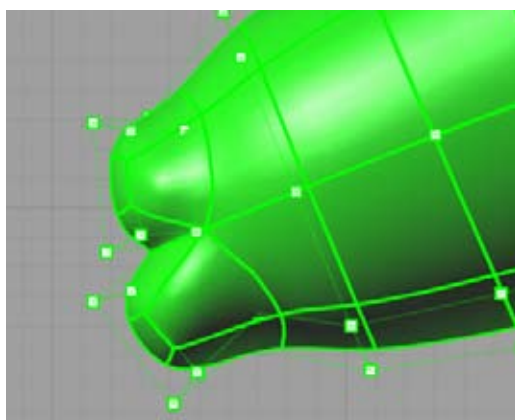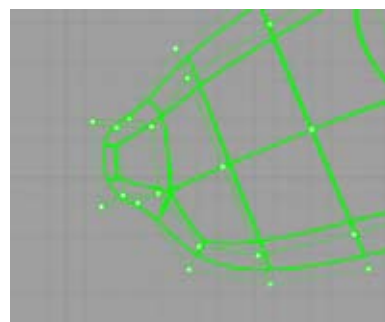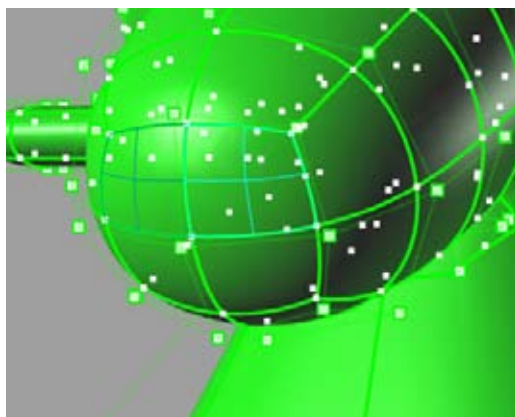
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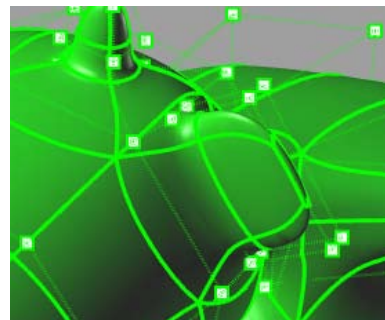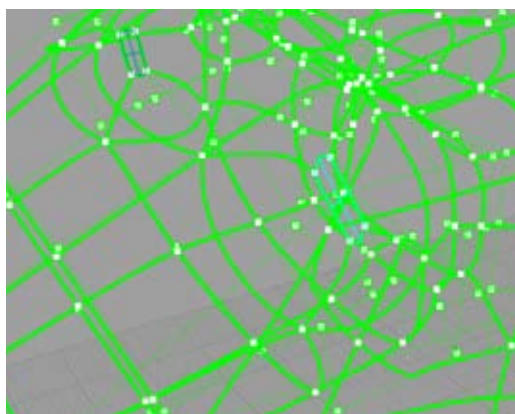
6 Mouth

Overview: This step introduces the concept of extruding two adjacent faces simulanteously to keep them merged together after the extrusion.

Run the tsExtrude command and select the two top foremost faces on the face. Selecting two side by side faces at once will extrude them merged.


Repeat the steps above with the bottom foremost faces.

Select the control points between the two lips created. Pull them back to create the mouth opening, then using tsManip, scale them along world X to get a smoother contour.
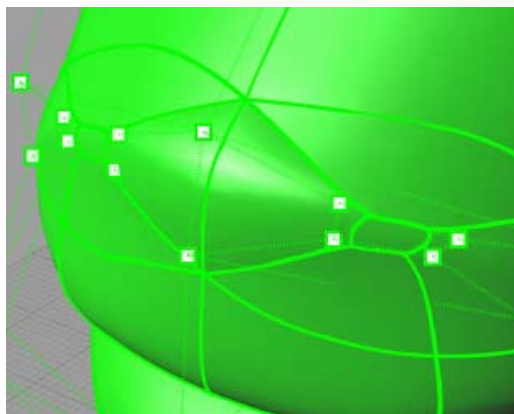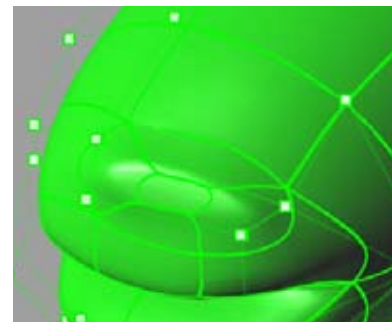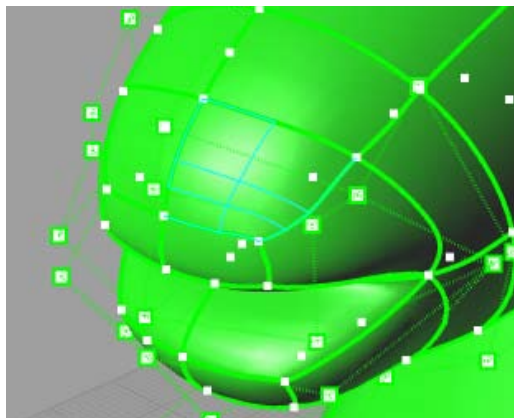
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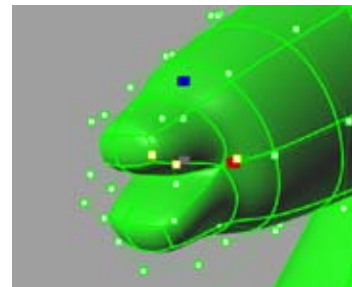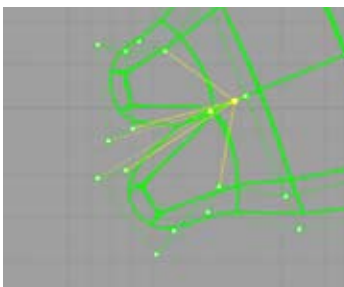
By using tsManip with the translate mode, drag the control points to fix the face around the mouth to get a smooth countour on the X&Z plane.
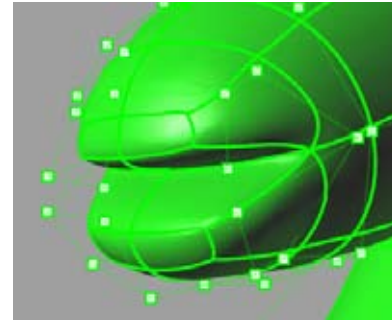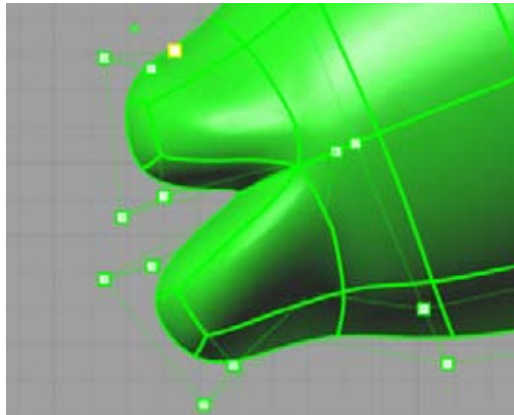
7 Nostrils

Overview: This step shows how to perform an inward extrusion.
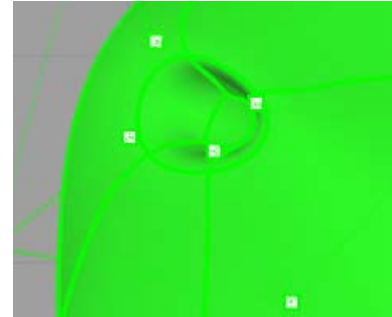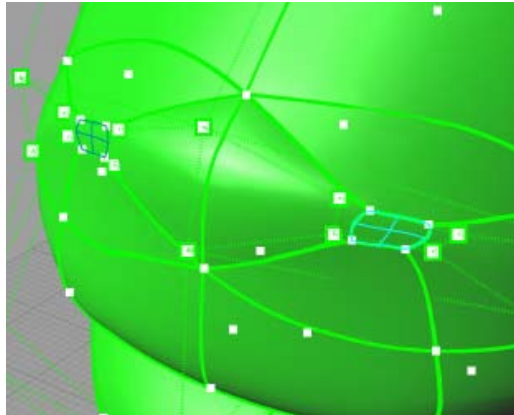
Run tsExtrude and extrude the face indicated by a small amount.

Repeat for the other side. Then, with tsManip, scale down the four control points for each new face like in the picture. Do this one face at a time, in all directions, by dragging the middle box.
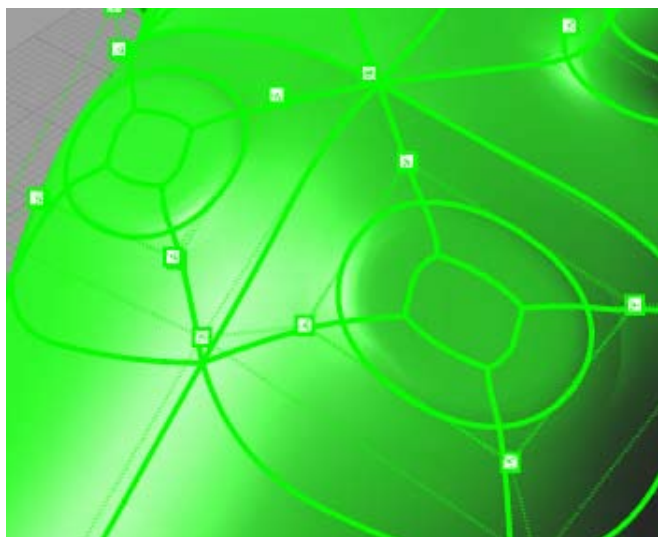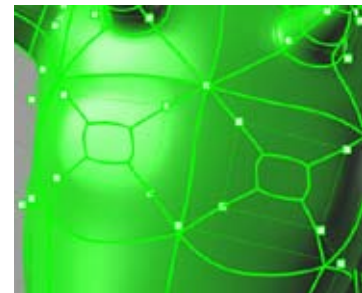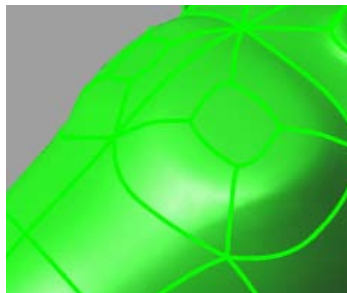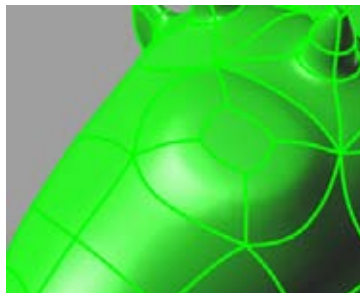
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Run the tsExtrude command and pick the two newly created faces. Extrude them inward to create the nostrils.

8 Eyes

Overview: The eyes are constructed in a similar manner to the ears and horns.
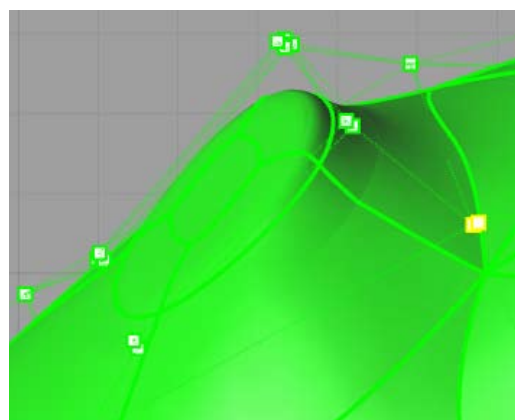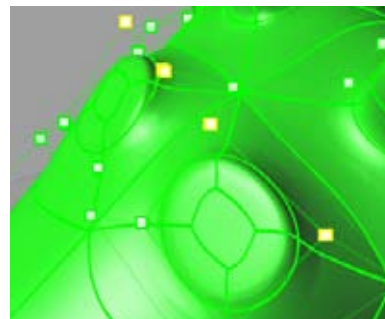
Now make the eyes by extruding one face as a time and scaling the control points as in the steps before.
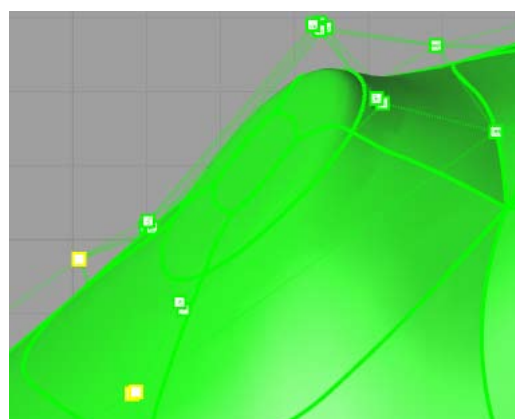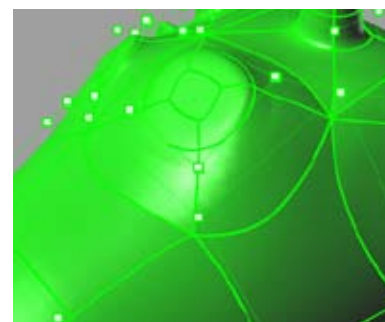

Extruding the center faces once more will convert them into a round shape as shown in the picture.
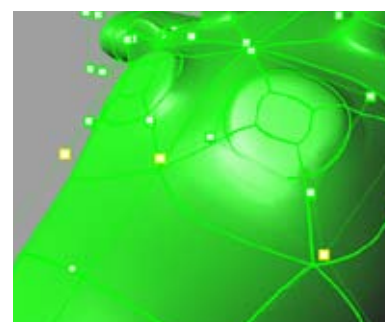
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Drag the top control points up with tsManip to make the eyes jump a bit, looking forward.

Drag the indicated control points up with tsManip to make the top of the head smoother.
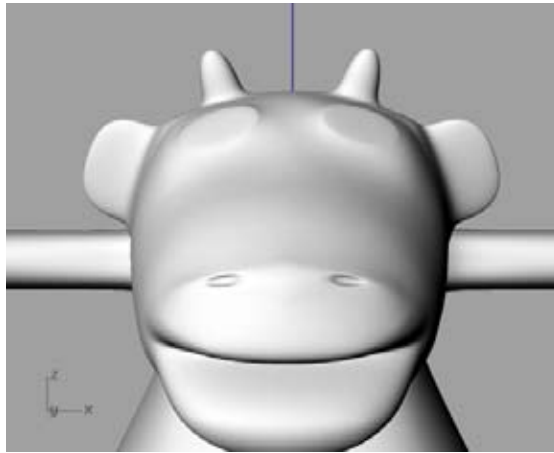

With tsManip in scale mode, scale the indicated control points in world X to open the face a bit.

T•Splines

The model has been kept in low resolution while it was being created. To increase the resolution and smooth the surface geometry, run the tsSetStarSmoothness command and set it to 4, then 8, to see the effect on the surface.
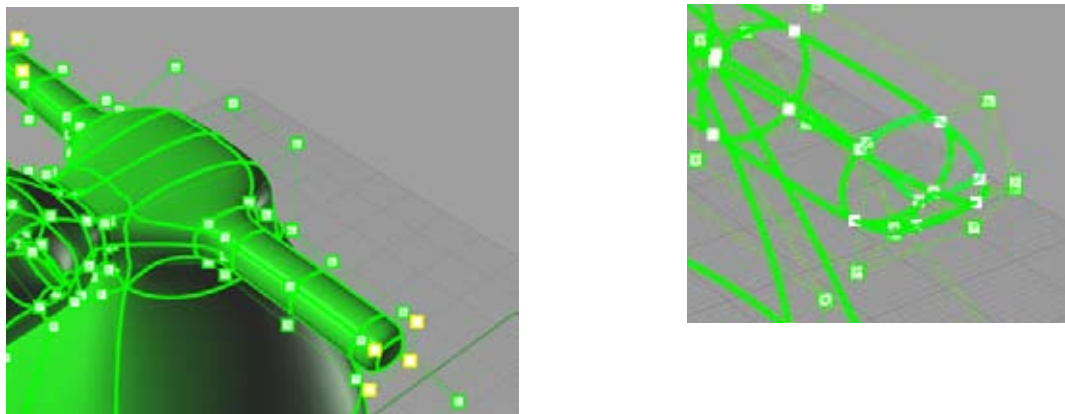

9 Hoof

Overview: The hoof is created similarly to the mouth.

Select all the control points defining the arm. With tsManip in scale model drag the green box (world Y) to scale down the points, making the arm round.
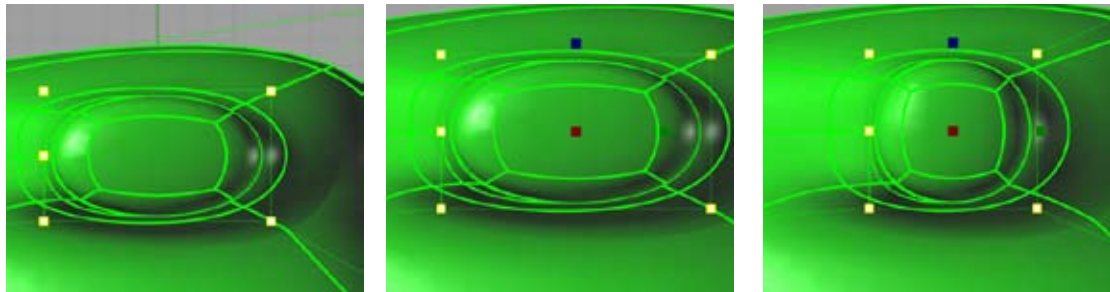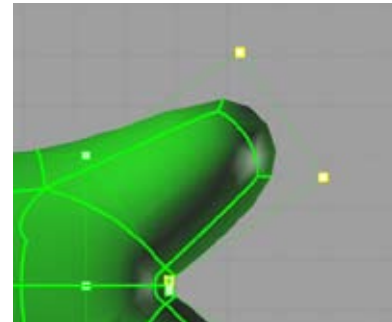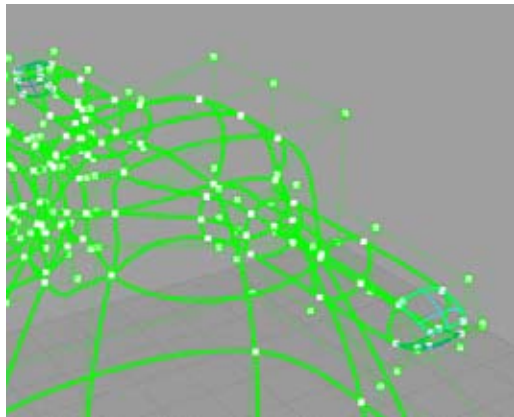

With the four control points on each tip of the arms selected, use tsManip to scale down on Z (blue box), leaving a small space between them.
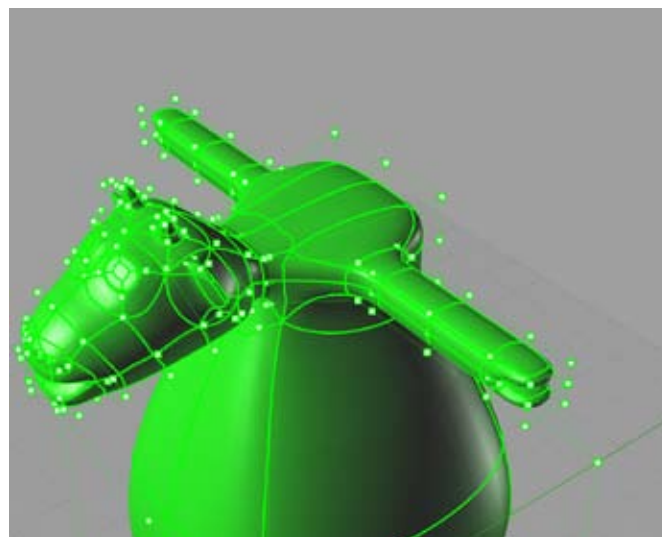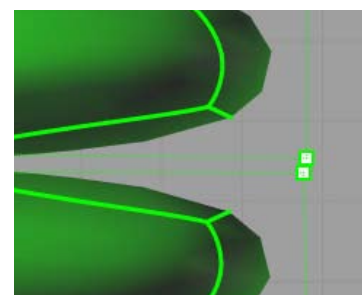
T•Splines

Run tsExtrude (with the perVertexNormal option) and select the four faces indicated. Extrude to make the hands.

Select the finger tip control points and rotate them to get the fingers straight. If after rotation the control polygons for each finger overlap, move the middle control points that overlap to separate the fingers.
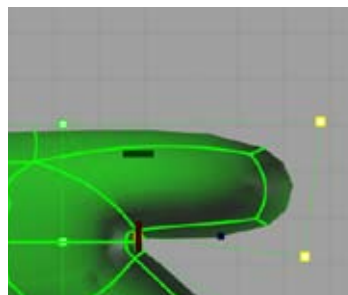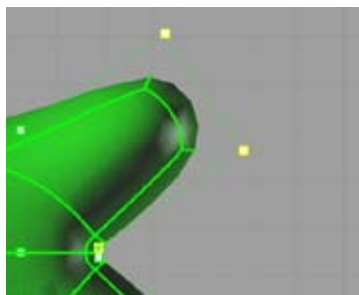
Now all the geometry is defined; time for tweaking. Go ahead and drag and rotate points to give it some character.

T•Splines

Conclusion

This tutorial outlines how to create an organic character using new tools available in T-Splines for Rhino 4: extrusion, rotation/scaling using manipulators, and inserting local detail. Each of these techniques provides advanced control for organic modeling not traditionally available in industrial design modelers such as Rhino.

Since this T-Splines model is completely NURBS compatible, it is now easy to perform Boolean operations on the model, as well as export it for manufacturing. The T-Spline model will automatically convert to NURBS for these operations, without any loss of detail.

For more information, additional tutorials, and a free trial of T-Splines for Rhino, visit *http://www.tsplines.com/rhino/*.

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