

Organic character modeling

Mastering 3D Graphics ~ issue #2

Electric Image Modeler ~ Eric Fernandes

Modeling a Human Head

After many years of waiting, Electric Image/Play finally shipped their ACIS-based modeling program this May. During this long development cycle, Electric Image listened to their users and beta testers concerning the kinds of features and tools they most wanted to see in a modeling program. Built around the needs of 3D animators, especially users of its popular Mac-based animation package, the EI modeler attempts to make modeling a flexible and intuitive process in the 3D design pipeline.



While not every feature request made it into the initial release (it had to ship someday) there are more than enough goodies provided to keep even the most avid power users busy. At least until version 1.1 arrives.

Introduction

The EI Modeler was built as a hybrid modeling application, providing the power and flexibility of Nurbs surfaces, such as those found in Alias PowerAnimator, while at the same time allowing for the mixing and matching of solid objects and polygonal meshes. No longer is the user constrained by the types of curves they're creating, or whether an object is single or double sided. Mix 'em and match 'em, the EI modeler will automatically figure out the proper way to put it all together.

Perhaps one of the most exciting tools in the EIM arsenal is its robust set of vertex sculpting tools, known as UberNurbs. Built from the ground up to facilitate organic modeling, these tools allow the user to shape objects as if they were made of clay, pushing and pulling vertices with complete flexibility and control. If you're familiar with Alias' clusters, or SoftImage's lattice deformations, you have a basic idea of the concept behind UberNurbs.

This tutorial is intended to get you up and running with the UberNurbs tools, while becoming familiar with one

set of techniques used to create an organic, human head. Once you've finished, you'll find it possible to create just about anything with UberNurbs, from a cat to a Klingon. As you proceed, feel free to make use of the sample project included with this tutorial. The head we'll be working on is saved in the supplied project file in four separate stages, from the initial rough blocking to the finished model. If you're a bit more adventurous, you can also scan in sketches or drawings to use as your own reference sources.

Getting started

So, pull the wrapping off that new CD and boot up your copy of the EI Modeler. On the Mac, I would suggest allocating somewhere between 70 and 90 MB of RAM to work with. Overall, the modeler is fairly stable for a 1.0 release, but there's nothing worse than spending an hour painstakingly sculpting vertices only to have the program crash while processing the UberNurbs shape. To be safe, allocate as much RAM as you can afford, while still leaving 8-10MB free for general system functions.

The bulk of this tutorial will consist of an explanation of what we're trying to accomplish in a given step, followed by bulleted instructions telling you what specific tool to use and how to use it. If you're not using the EI modeler,

feel free to read the descriptive areas only and try to replicate the results in your own program, using your specific toolset. As long as you have the ability to place and move weighted vertices you should be able to achieve similar results.

I'll also attempt to highlight some helpful keyboard shortcuts and time saving commands as we go. The first keys that you should commit to memory are the positional commands for navigating around in the windows. While creating complex UberNurbs shapes, it's vital to be able to move around your object freely in order to select and view specific vertices that might be layered on top of each other. A few helpful key commands here are:

O: Hold down the O key and click-drag the mouse in the perspective window to orbit around your model. If you use this command in an orthographic window, it will switch to a perspective view. Hold down the Control key in that window to re-establish an orthographic orientation.

Command-Spacebar: While holding down these keys, click-drag in any window to zoom in and out.

Spacebar: Hold down the spacebar and click-drag in any window to translate the view.

UBER-Nurbs: Getting Started

Ready to dive in and start sculpting? Open up the UberNurbs tab set in the tool palette if it's not already open. There are 16 different UN tools and we'll use most of them by the time we're through. With the exception of the first tool (edit UN cage) all of the UN tools are single command tools, with no modifier dialogue boxes. Also, you can only use the UN tools when you are in UN edit mode. Clicking on any of the tools when not in UN edit mode will have no effect.

First, we need to supply a primitive object to convert to an UberNurbs shape. When a shape is first converted to an UN object, each loop (a set of connected edges, also known as a face in other programs) is constructed with a loop center and a vertex in each corner. To be converted to an UN shape, an object must have at least 3 individual loops, with each loop having at least 3 or more edges that are shared by 2 perpendicular faces. Thus, a sphere – since it has only one face, or loop – can't be converted to an UN shape. Neither can a cylinder, since it's top and bottom loops are shared by the side loop; in essence giving you 2 shared loops. If you're not into the remedial geometry lesson, suffice it to say that the recommended shape to begin your UN modeling is a cube primitive, with its 6 uniform, 4 edge loops. This creates the perfect, round “lump of clay” to begin with.

- ♦ Double-click on the **cube primitive** tool in the Solid Primitives menu tab. Enter 9" in the x, y & z edit boxes and hit return. You should now have a solid, square cube. Zoom in manually, or hold down the F key while clicking in the window to automatically fit the cube to the window.

At this point, I would recommend switching to flat or smooth shading in the perspective window (hold down control and click in the perspective window to bring up the shading options). I find that using smooth shading in the perspective view is a good way to work with solid, organic objects, because it provides a rough sense of the contours of your model that a wireframe view lacks. You'll also need to arrange a few lights in your project to get a general idea of how light will hit the edges of your model and to minimize any harsh shading that would give a false sense of depth. I find that a standard 3-point lighting setup works well, using key, fill and back lights. It's also sometimes helpful to add a 4th light underneath the model if you need to make adjustments underneath (see [Figure 1](#)).

All right, now we're ready to sculpt. Scroll back down to the UN tool palette tab. The first tool you'll see is

the UN/Edit Cage tool. This tool converts a standard object into an UN object and also allows you to edit an existing UN object. If you double-click on it you will see a number of options. The first edit box defines the default vertex weight. The weight of any vertex ranges from 0 to 1, with 1 pulling the geometry 100% toward the vertex and 0 pushing the geometry 100% toward the center of the loop.

If each vertex is created with a default weight of .6, the initial UN object will look like an egg, with rounded corners. If you were to increase the weight of all of the vertices to 1, you would end up with an object resembling your initial cube primitive, with all of the geometry pulled toward the corners. We'll want to stick with the default weight and manually adjust the weight of individual vertices as we go.

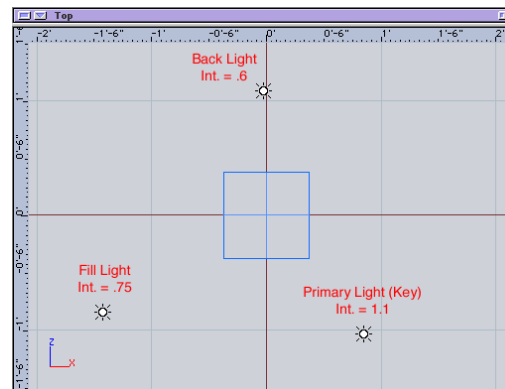


Figure #1

The other important option in the Edit Cage dialogue is the choice of creating a full ACIS object upon completion, or leaving your model as a semi-converted UberNurbs object. Generally, it is best to keep it as a semi-converted UN object, which will require much less memory and a smaller file size. If you need to perform other operations on your UN object, such as a

boolean operation, or a knife cut, it will be necessary to convert the model to a full ACIS object first. If you attempt a boolean operation on a non-ACIS UN shape, the program will display a warning and then automatically convert your model to an ACIS object first. I would recommend keeping your object as a semi-converted UN object until you are completely finished editing it and then do any booleans or non-reversible alterations as the last step.

- ♦ With the **UN Edit Cage** tool selected, click once on the cube. The corners will become rounded and the initial UN cage is established.

This initial UN cage has very few vertices to work with, so right away we should do a global subdivision. This will divide each loop into 4 smaller loops, and give us 27 vertices to play with instead of the initial 8. That should suffice for sculpting the rough shape of the head. In general, I would never recommend doing more than one or two global subdivisions on a model, as you'll end up with a lot of edges (lines between vertices) and loops that are unnecessary. Instead, do one or two general subdivisions in order to create the rough shape and then add edges and vertices specifically where needed later.

- ♦ Select the **Global Subdivide** tool in the UN palette and click once to perform a single subdivision on the model.

Your cube will now look more square, as we have increased the number of vertices on the outside edges of the cube, pulling geometry away from the center.

Defining the profile of the head

Next, we need to start defining the shape of the head. I like to start by sculpting a rough profile in the side view. There are a couple of ways to create a profile that you like. One is to use a scanned photograph as a background template. This is helpful if you already have drawings or reference images of a specific character you're trying to create. To load a background image as reference, hold down the control key and select the load image option in the desired window. You can then scale and translate this image in the background. Another method for creating a profile is to work like a sculptor and push vertices around interactively, until you have something you're happy with. Since we're not trying to make this model look like a specific character, I'm going to take the sculpting approach.

- ♦ Switch back to the **Edit UN Cage** tool. Starting in the Left view window, select and move vertices on the y and z-axis until you have a basic profile of a head, including the nose. Don't worry about being perfect. We'll refine it later. You may want to drag a marquee selection around vertices before moving them to make

sure that you've selected all of the vertices on that edge. For now, we want to keep everything symmetrical. Also remember to shift-click in an empty region to de-select vertices when you're done moving them. Another handy keyboard shortcut to use here is to hold down the **s** key along with either the **x**, **y** or **z** keys, in order to scale selected vertices along an axis. For instance, if you want to squash the entire head on the Z axis, simply drag-select all of the vertices of the head and hold down **s-z** while you drag the mouse left or right. Additionally, you can hold down any of the axis-lock keys (x,y,z) alone and any translations you perform will be confined to that axis. Finally, using the **r** key with (or without) axis constraints rotates the selected vertices. With those basic concepts try to create a profile that looks something like [Figure 2](#).

Here are a couple more general tips I've found to be helpful while editing UN shapes:

One drawback in UN editing (and which EI is addressing for a future release) is that there is no in-tool

undo feature. If you accidentally yank a few vertices someplace you didn't want them, your only option is to try to move them back the way they were, much like trying to fix a broken egg. Thus, I find it essential to routinely save the current UN shape by exiting the edit mode (double-click) and re-entering it again. This locks in any changes you've made and you can then revert back to this shape at any time. Once you've done this, re-enter edit mode and continue working. If

you make a mistake, simply hit the Escape key and back out of edit mode without processing the cage. The model will revert to the shape it was before. Additionally, you can use the multiple undo feature to revert back to any other changes you've made along the way as long as the shape was processed.

You'll often find that as you edit an UN shape the shaded view will become distorted and artifacts will pop up. By pressing the **TAB** key twice, the model will be redrawn and the surface shading will be recalculated. By the way, when you press **TAB** once, the display changes to show only the vertices and edges. This

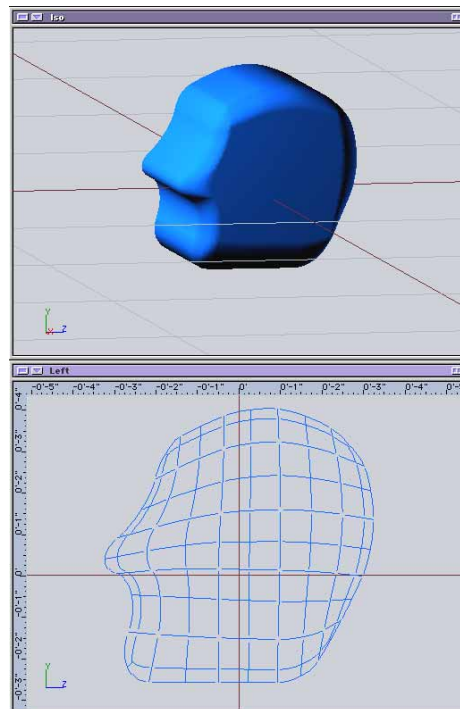


Figure #2

mode can also be helpful when you're trying to quickly edit a shape and don't need to see all of the underlying isoparms.

Back to our head. Next, we want to mold the general contours of the head from the front. We'll use another tool here to keep everything symmetrical, enabling us to edit one side of the face and automatically mirror the changes on the other.

- ◆ Re-enter the **UN edit** mode. Select the **Symmetry** tool (2nd to last). In the Front view, drag and release a rubberband line down the middle of the model on the y-axis. This tells the program to automatically mirror the movements of vertices on one side of the rubberband with those on the other side. You can adjust the tolerance of the symmetry tool, as well as reset it completely, by double-clicking on the edit cage tool.

- ◆ Once we've established the symmetry it will only be neces-

sary to move vertices on one side of the face. In the Front view, while holding down the **x** key (constrain translation to the x axis) move the vertices until you have something like **Figure 3**.

Now we have something resembling a head, with the front and side profiles roughed out. Next we'll move to the top view and make a few changes there. Obviously, the most glaring problem at this point is the uni-nose, which covers the entire face. We need to push the vertices on the edges back so that the nose only extrudes from the middle of the face (unless you're working on a Star-Trek alien). The easiest way to select these vertices is in the Top view as you can see in **Figure 4**.

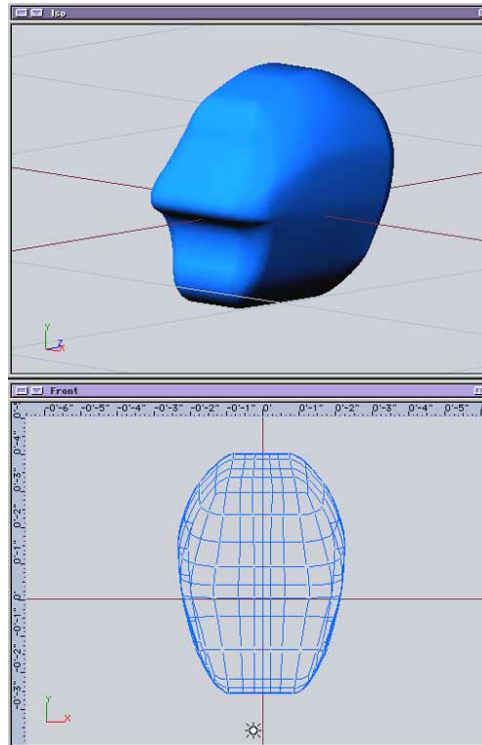


Figure #3

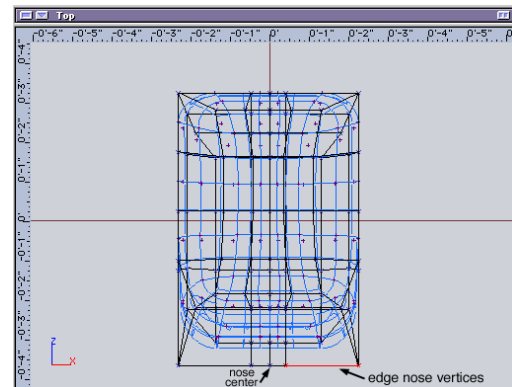


Figure #4

- ♦ Make sure your symmetry settings are still active. Select the front extruding nose vertices on the edge of the face and move them back on the z-axis until they are roughly flush with the rest of the face (check the shaded view to confirm this).

You should now only have 1 vertex sticking out to form the bottom of the nose. At this point, it may look a bit stubby. To fix this, try giving the nose vertex more weight.

- ♦ Select the nose center vertex and while holding down the **w** key, drag the mouse to the right. This will increase its weight. Drag the mouse left to decrease the weight. Drag back and forth until it looks how you want it to.

You can also reset the weight of a selected vertex at any time. Simply double-click on the edit cage tool and press the reset button under the default vertex weight dialogue box. The vertex weight will automatically change to the value in the dialogue box. Using the same method, you can reset the weight of multiple ver-

tices at once. At this time, there is no way to view the actual weight of specific vertices, but it is a feature EI plans on adding in a future release.

So far so good. You should now have something resembling that shown in [Figure 5](#).

Chin Detail

Next, we'll begin to detail specific areas of the face. One of the difficulties in working with complex, vertex-based structures is that as your model progresses in complexity, it's very easy to get lost in a sea of layered points and edges. Soon you'll find that it takes five minutes to locate and select the vertex you're looking for. To solve this problem we're going to make use of the **UN visibility** tool. This allows us to interactively turn off portions of the UN cage, so that we can easily select and edit only the sections we are interested in.

- ♦ Select the **visibility** tool (the last tool in the UN palette). In the Left

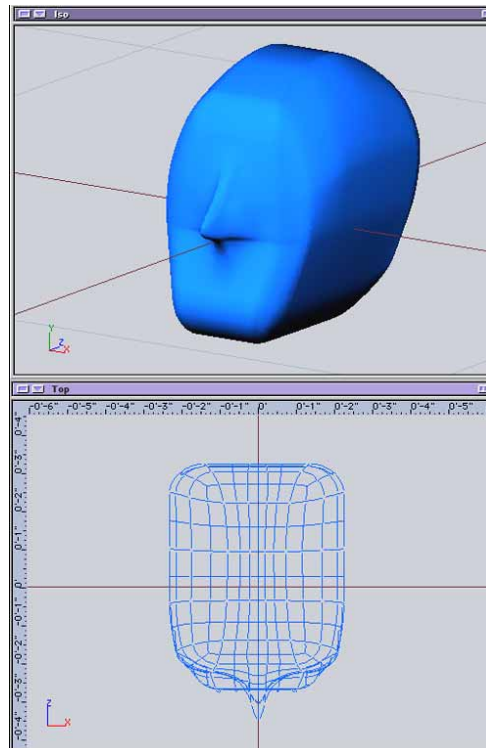


Figure #5

window, drag a selection marquee from the first series of edges behind the face to the back of the head. Continue making sections of the head invisible until you're left with only the front of the face visible. To make the cage visible later, hold down the shift key while using the visibility selection marquee. For now, we just want to see the vertices on the front of the head. Now is a good time to process your cage before continuing to edit, since the visibility settings will also get locked in (see Figure 6).

Now we can begin to add detail to the front of the face. We'll start with the chin and work our way up.

- ♦ Working in the Front view, make sure the symmetry is still set to the middle of the head, and begin

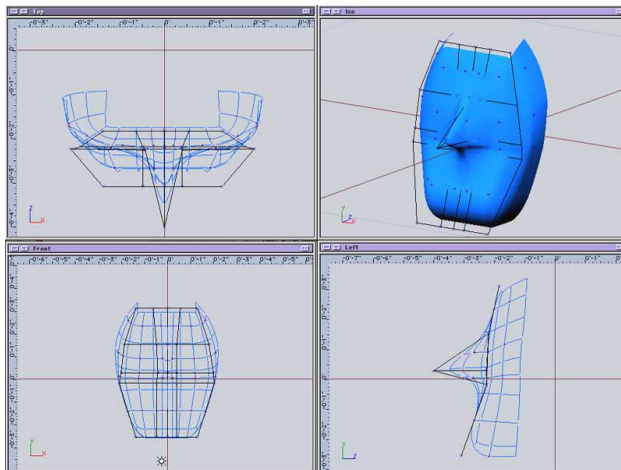


Figure #6

rounding out the vertices on the chin. Move the far outside vertices up a little on the y-axis and in on the x-axis. Then move the same vertices back on the z-axis in the side view to round out the contours of the chin. Finally, pull down the center vertex on the y-axis to round out the bottom. You should have something like that shown in Figure 7.

Next, we need to add a few extra control points in order to define the upper chin and begin the transition into the mouth. Right now, the vertices in the chin connect directly to the vertices under the nose. So, we need to add a few extra edges between the two. For this we'll use the **Add Rib** tool. The add rib tool creates a new edge between 2 or more existing edges. Take note; if you haven't made the back part of the head invisible at this point, you will end up adding extra ribs that you don't need to the back of the head as well as the front.

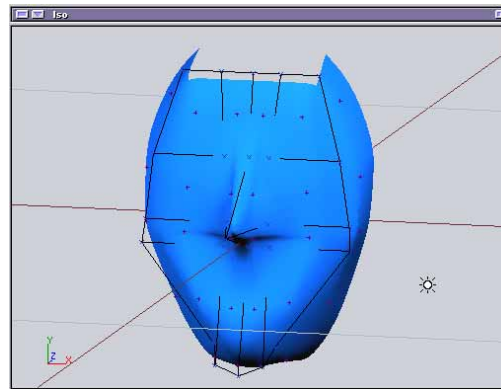


Figure #7

- ♦ We'll need 2 additional, horizontal edges to define the chin area and lead into the mouth. In the Front view, with the **Add Rib** tool

active, drag 2 straight horizontal lines between the existing vertical edges in the chin. Tip: Start dragging the new rib a little before the first edge and release it a little after the last edge (see [Figure 8](#)).

The lower of the 2 edges you just added is going to be our chin riser, which will push the chin out. The edge directly above that will be pushed in on the z-axis to define the region between the chin and the lower lip.

- ♦ In the Front and Side views manipulate the 3 vertices on chin riser until it's sticking out where you want it. Make sure to push the 2 outside vertices back on the z-axis behind the center vertex. This will round out the chin on the sides. You may also want to scale the chin riser out on the x-axis to enlarge the chin area. Then, push the 3 vertices on the chin spacer rib back

on the z-axis to smooth out the transition between the chin riser and the rest of the face. It should look something like [Figure 9](#).

The Mouth

Following along so far? Now it's time to add the mouth. We'll need a total of 6 extra edges between the chin spacer and nose to create the mouth. To create the mouth cavity I'm simply going to pull one vertex back into the head. When it's time to animate the mouth, we can add a couple of extra vertices inside to further define the cavity if necessary. To illustrate how the mouth should be built take a look at the side view in [Figure 10](#).

- ♦ In the Front view, using the **add rib** tool, add 6 horizontal edges between the chin spacer and the lower

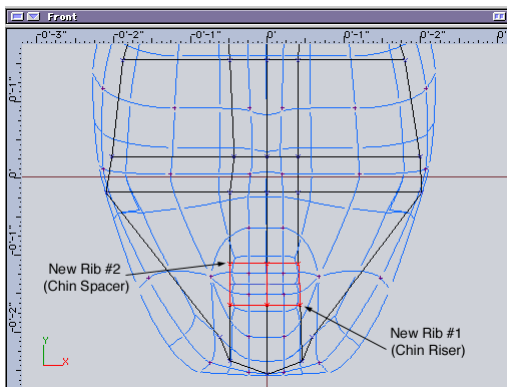


Figure #8

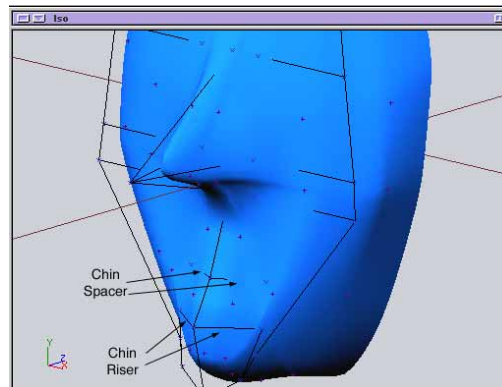


Figure #9

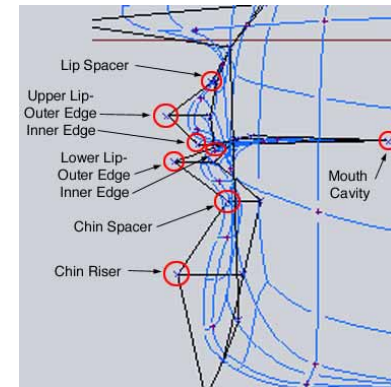


Figure #10

part of the nose. Each new edge should have 3 vertices.

- ♦ The first edge above the chin spacer will be the outer lower lip. Pull it out on the z-axis, with the center vertex sticking out the most. You'll probably also want to stretch these vertices on the x-axis to make the lip wider. Select all 3 vertices of the edge and hold down the **x-s** keys while dragging the mouse in any window.
- ♦ The next edge up will form the inner edge of the lip and will define its depth. Move these vertices up, and back on the z-axis to create the shape of the lower lip.
- ♦ The next edge up will serve as our mouth cavity, creating a hole in the face where we can later place teeth and a tongue. Scale it slightly smaller than the lower lip on the x-axis. Then, take the center vertex and push it way back into the head on the z-axis. This will create the interior cavity. You can also move the outer vertices back slightly to create a pinch in the corner of the mouth. It should look something like [Figure 11](#), with the chin and lower lip defined.

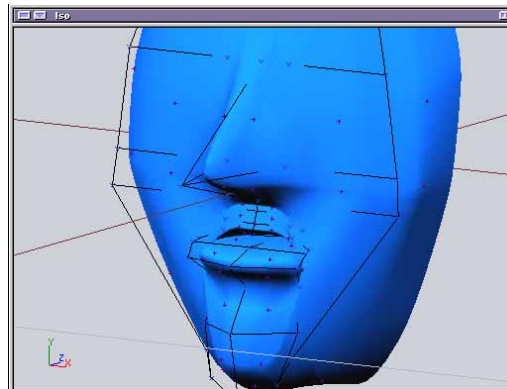


Figure #11

Don't worry that the mouth and chin areas aren't connected to the sides of the face very well. When we're all done here we'll connect a few edges between the edge of the mouth and the cheeks to smooth everything out. For now, you should have a nice protruding lower lip and a hole going back into the head.

- ♦ Select the next edge up in the mouth area (the one directly above the mouth cavity). This is going to define the inner upper lip. Scale this edge on the x-axis so that it is slightly larger than the mouth cavity below. Move these vertices down on the y-axis so that they're almost touching the mouth cavity vertices. We're going to model the character with the mouth closed and the lips touching. You'll also want to move the outside vertices back on the z-axis a little to round out the upper lip.
- ♦ Finally, we'll finish creating the upper lip by defining the outer edge. Select the vertices of the outer upper lip and move them out on the z-axis. Scale them on the x-axis so that they're slightly smaller than the vertices of the inner upper lip below. Also, make sure to push the center vertex out further on the z-axis to round it out. You may also

wish to adjust the weight of the center vertex to firm up the lip.

To finish this area and transition into the nose, we need to define the edge between the upper lip and nose.

- ♦ Move and scale the vertices between the upper lip and nose until you have a smooth transition between the two areas.

You should end up with something like that shown in [Figure 12](#).

One other thing we should do to finish up the mouth region is give some shape to the lips. Right now they're pretty flat. Use the visibility tool to turn everything off but the lips.

- ♦ Push the exterior edges of the bottom lip up and back. Push the edges of the upper lip down and back to give the lips a fuller, more natural appearance. Also,

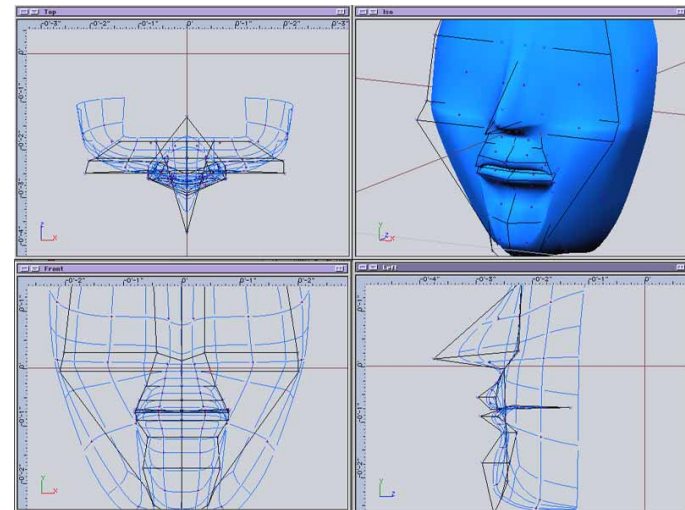


Figure #12

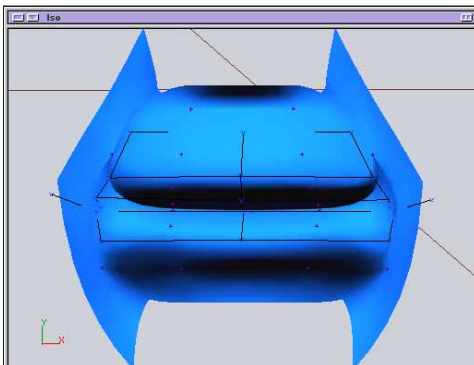


Figure #12a

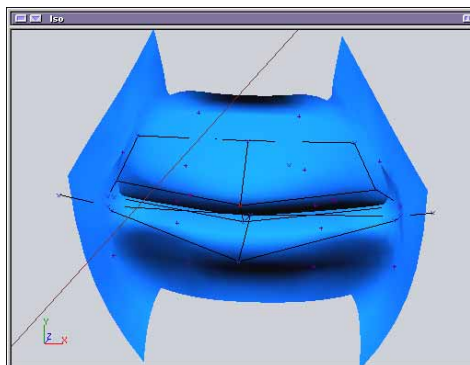


Figure #12b

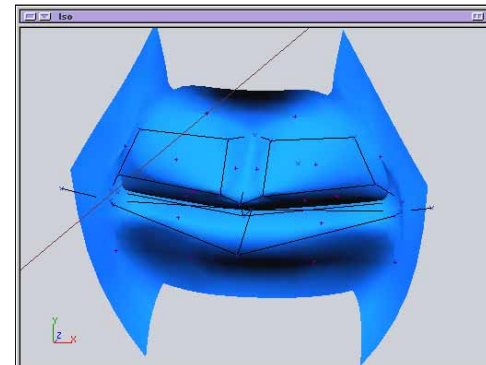


Figure #12c

play with the position of the exterior center vertices to enhance the depth of the lips (see [Figure 12b](#)).

To finish off the lips we'll add a furrow between the nose and the upper lip.

- ♦ Add a rib on either side of the edge between the upper lip and the nose. Keep these new ribs fairly close to the center edge. Once you have these extra edges in place, push back the center edge on the z-axis. Play with the weights on the upper and lower vertices until you get something like [Figure 12c](#).

If you want to increase the detail later, add a few more vertical ribs between the center and the edges of the lips. Then you can manipulate the extra vertices to give the mouth that extra curvy, lipstick-on-a-napkin outline.

are 2 sets of horizontal edges on the front of the face (below the nose) that are basically representing the same geometry. Simplifying redundancies like this as we go will make the animation process flow much smoother as well as keep our model organized. We only want edges and vertices to be placed where the muscles or major facial groups are defined (see [Figure 13](#)).

- ♦ Select the **delete edge** tool in the UN palette and click on each of the exterior horizontal edges near the nose so that there is only one horizontal edge extending out from the nose in the middle of the cheek.

Don't worry if deleting the edges alters the geometry a bit. As we connect new edges, the cheek region will begin to smooth out. First off, we need to add extra edges in the lower cheek to create the fleshy ridges that border

Cheeks

OK. It's time to work on the cheek area. Before we do that, you'll find that sometimes as you're molding an organic character you'll end up with edges and vertices that you don't need. Looking at our model, I've noticed that there

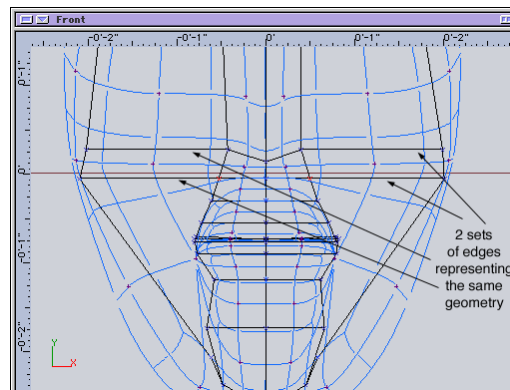


Figure #13

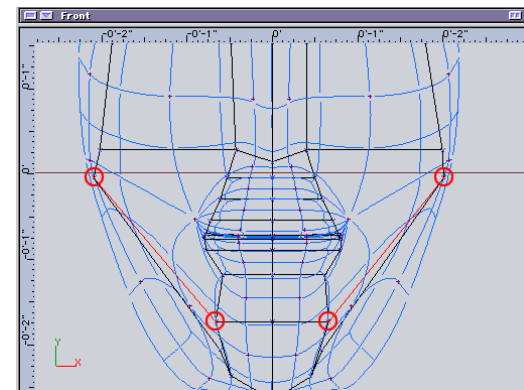


Figure #14

the sides of the mouth. To do this we need to connect some of the vertices near the chin with the vertices on the edge of the cheek.

- ♦ Select the **add edge** tool in the UN palette and in the Front view connect the vertices as shown in [Figure 14](#).

This creates a connection between the chin and cheek muscle. Next, we'll need to add a vertex in the middle of the edge we just created. This is where we'll connect the lower cheek muscle to the mouth, creating the ridge.

- ♦ Select the **add vertex** tool and in the Front view, place a new vertex somewhere in the middle of each of the edges you just created. Once you've done that, select the edit tool and move these new vertices until they are near the corners of the mouth.

We will now use these lower cheek vertices to create 2 new edges and form the lower cheek ridge.

- ♦ Select the **add edge** tool and connect the new vertices to 2 other vertices. First,

connect them to the top edge of the outer lower lip and then connect them to the edges of the nose.

You should end up with a lower cheek “muscle” that connects like that shown in [Figure 15](#).

Now you've created the edges for the ridge surrounding your mouth that your aunt used to squeeze when you were 5. But ours is still flat. We need to “fatten” it up.

- ♦ Select the 2 vertices you added in the center of this muscle and pull them forward on the Z-axis. This will create a nice, fleshy ridge.

Finally, for the last touch on the cheeks we'll need to add the upper cheek fat pad and connect it to the lower cheek muscle. If you look in the Front view there should be 2

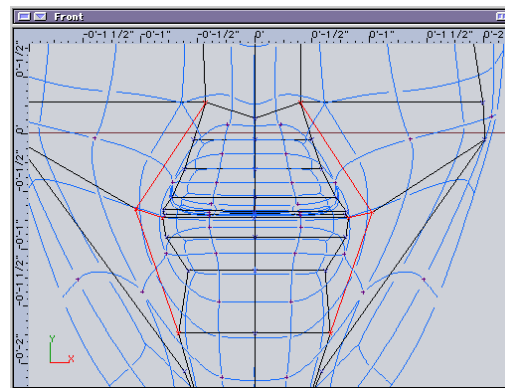


Figure #15

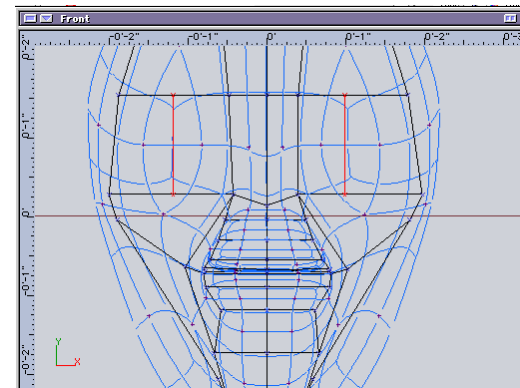


Figure #16

horizontal edges that extend from the sides of the nose outward. We'll add an extra vertical rib in the middle here and then use that to connect to the lower cheek.

- ♦ Select the **add rib** tool and in the Front window create an extra vertical rib along each side of the nose (see Figure 16).
- ♦ Next, using the **add edge** tool, connect the lower vertices of the new edges to the middle lower cheek ridge vertices. This will connect the upper cheek to the lower cheek. Finally, select the end vertex of the upper cheek edges and pull them forward on the z-axis to flesh out the upper cheek fat ridge.

Voila, you should have something like that shown in Figure 17.

Don't be concerned if yours looks a little different (for better or worse). The main thing to learn here is how to use the UN tools, along with a general technique for defining facial muscles and features. Once you have a good grasp of the tools and process anything can be accomplished given enough time and practice.

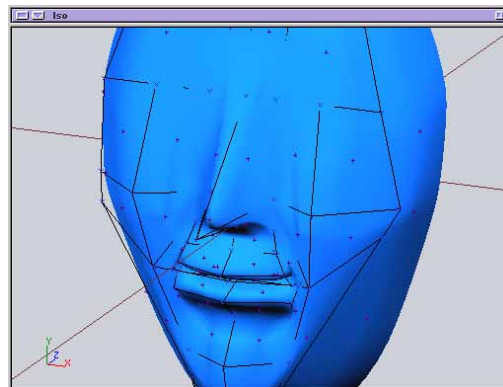


Figure #17

Nose

Next, let's tackle the nose area. Right now, the nose is defined by a single vertex extruding out in the z-axis. It's great for a cartoon character, but we can do better than that for our human head. First, we'll need to add a rib on either side of the existing edge in order to further define the nasal bone.

- ♦ Using the **add rib** tool, add a new vertical rib on either side of the nose. In the Side view, pull the bottom vertices of these new edges out on the z-axis until they are almost even with the tip of the nose. At this point, you may also want to reduce the weight on the tip of the nose if you had increased it earlier.

Next, we'll need to add the nose wings and a nostril cavity. To do this, we're going to need some more control vertices. It's time for a new tool: the **subdivide loop** tool. This will divide the selected loop into a series of smaller loops, giving us more vertices to work with.

- ♦ In the Perspective window, rotate the view until you can see underneath the nose. On either side of the nose, you should find the center of a loop – between the nose center

and the new edges you just added – represented by a small purple cross. To make sure you have the right loop, click on the cross with the edit tool selected. This will highlight the loop edges and all of its vertices. Once you've found the correct loop under the nose, select the **subdivide loop** tool. Click once on the center of each loop to perform the subdivision.

- ◆ Next, select the vertices on the exterior sides of the nose in the loops that you've just subdivided and scale them out on the x-axis. This will flare the sides of the nose out to form the nose wings. Finally, select the center vertices in the loops and pull them up into the nose, creating the nostril hole. When you're done, it should look something like [Figure 18](#).

The last step in defining the nose requires a subdivision of the nose wings so that we can round them out properly.

- ◆ Using the **subdivide loop** tool again, select the center of the first loop up on both sides of the nose exterior. Using the **edit** tool, pull the center vertices of these

newly subdivided loops out on the x and z axis to round out the nose wings.

You might also want to pull down the exterior vertices at the top of the nose to help define the nose wings. Right, now the nose wings may be blending in to the top of the nose too much. Try bringing the upper nose vertices down and then adding an edge to connect them to the upper cheek area. This creates a nice furrow on the sides of the nose. Before you're done you may also want to use the add edge tool to connect a couple of vertices at the bottom of the nose to some in the middle of the wings. One thing about organic modeling is that there really is no right or wrong way to do things. There are as many different kinds of noses in the world as you can model. In the end, you should have something like [Figure 19](#).

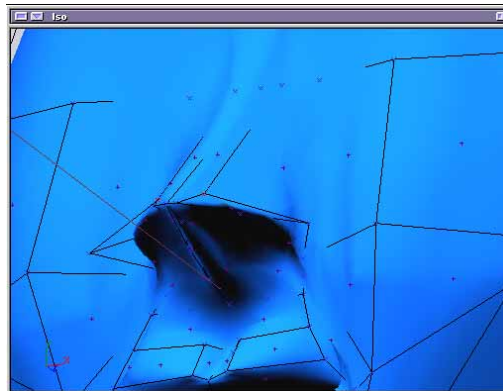


Figure #18

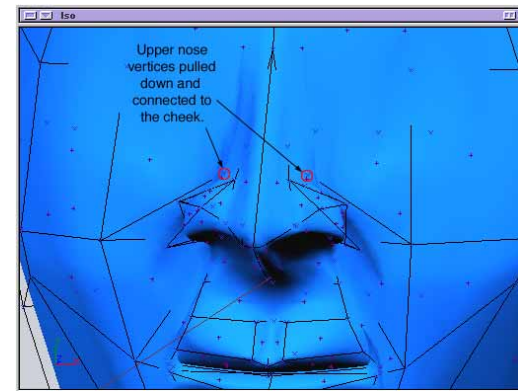


Figure #19

Brow Ridge and Front Face Shaping

OK. It's time to quickly refine the upper part of the head before we add the eyelids and eye sockets.

- ♦ Create a brow ridge above the nose by adding an extra horizontal rib using the **add rib** tool. Push those new vertices in on the z-axis to define the brow and flatten the forehead. You'll also want to scale and sweep the sides of the cheek back around the head. Smooth out any rough edges and make sure the top of the head is rounded off as well.

Shoot for something like that shown in [Figure 20](#).

The Eyes

Congratulations. You've made it this far and it's time to add the final detail feature to the face; the eyes. We're going to use a similar technique for the eyes as we used for the mouth. The entire eye region can be created with a total of 8 edges per eye.

- ♦ First off, clean up the region where you are going to

place the eyes. Move any surrounding vertices up or down so that you have a clear area (horizontally) to add new ribs. As you can see in [Figure 21](#), I started with 3 vertical edges in each eye region. It's helpful to push the existing vertices into a rough, round eye shape before adding the ribs, although I didn't do that in my model.

- ♦ In the Front view, using the **add rib** tool, add 5 new horizontal ribs on each side of the nose where the eyes will go. This will form the tear bag and lower part of the eye. Once you've added the ribs, begin to push the new vertices into a final eye shape (low in the middle, up at the corners). If you had a rough eye shape in place before you added the ribs this step will be easier. Starting at the bottom, the base horizontal edge that you began with will represent the edge of the cheek.

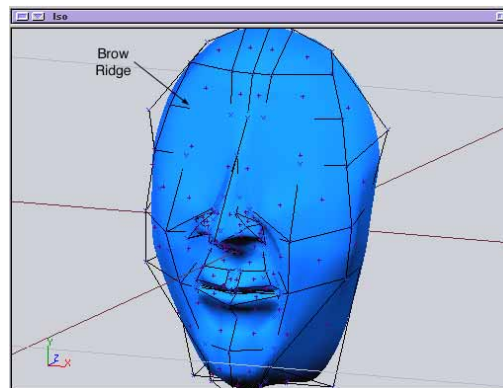


Figure #20

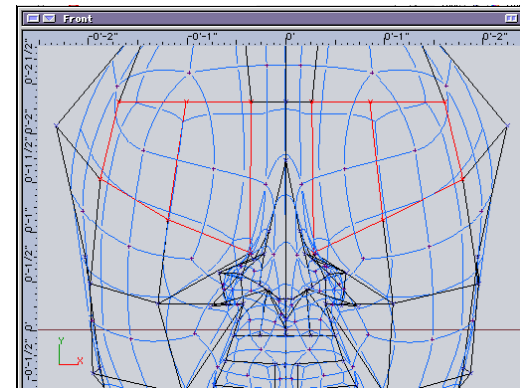


Figure #21

The next edge up (new rib#1) will start the tear bag and should be indented in on the z-axis. The next rib (#2) will extrude outward on the z-axis as the edge of the tear bag, giving it a puffy look. The next rib (#3) will form the top of the tear bag and the lower part of the eyelid and, should be pushed back in toward the head on the z-axis. The next rib (#4) will form the top outer edge of the lower eyelid and should extrude out slightly from the previous rib, especially in the center vertex. Finally, in the last rib (#5), the center vertex should be pushed into the head to make a cavity for the eyeball.

Mold and push these new vertices until you have something that looks like an eye, with whatever level of age that you want; old and puffy, or young and taut. As with the mouth, extra vertical ribs can be added later to en-

hance the detail of this area. For now, we'll just work with the 3 vertices per edge. This close-up perspective shot shows how these 5 ribs form the tear duct and lower eye (the edge lines have been artificially highlighted so you can see them – [Figure 22](#)).

- ♦ To add the upper eyelid, in the Front view create 3 new horizontal ribs above the ones you've just created for the lower part of the eye. Mold these 3 new edges into the form of an upper eyelid (up in the middle, down in the corners). The bottom rib will form the exterior bottom ridge of the upper eyelid. The middle rib will form the upper ridge. The 3rd and final rib should be pushed up and outward to form an upper eye fold. In the side and front views, translate these ribs until you have a nicely shaped upper eye that looks something like [Figure 23](#).

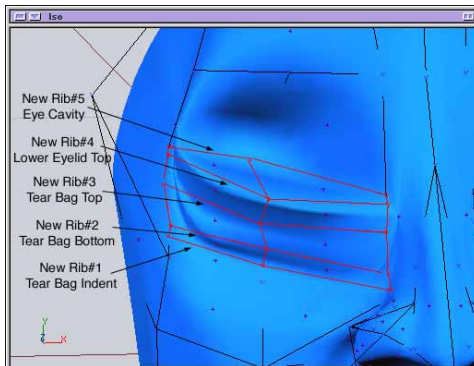


Figure #22

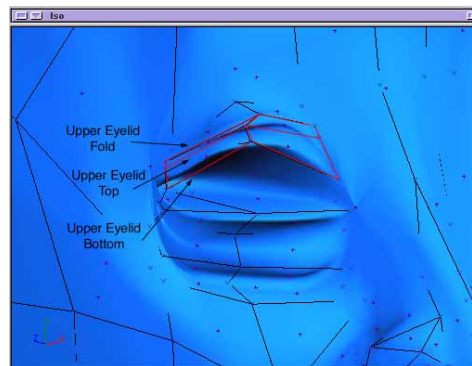


Figure #23

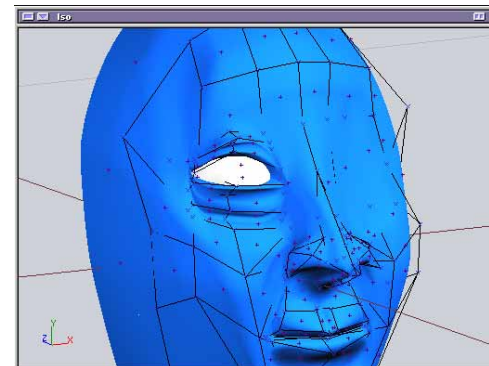


Figure #24

Add a sphere for an eyeball and he's starting to take shape (see [Figure 24](#)).

Unfortunately, when you add ribs, the symmetry tool won't reflect them. Thus, you need to go in and manually repeat the above steps to create the other eye. Think of it this way: it's more time consuming, but you'll get that imperfect, non-uniform, organic look. Stick to the same techniques and when you're done you'll have a nearly finished basic head like that shown in [Figure 25](#).

Final Head Sculpting

All right, we're just about done. It's time for some final shaping of the head and you have a shot to use all of the tools you've learned so far.

- ♦ First, make your entire model visible, using the visibility tool while holding down the shift key. With the scale and translate tools, sculpt, shape and blend the edges, top and back of the head until the facial

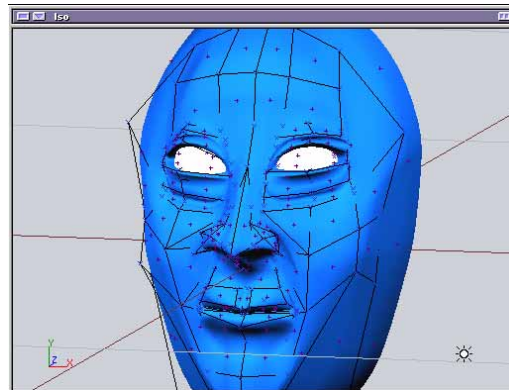


Figure #25

area you've been detailing blends in nicely with the rest of the head. One good way to interactively sculpt is to select an entire row of vertices in the side view and then hold down the **x-s** keys while dragging. This will scale the entire row on the x-axis only. You can also use the perspective window to select edges and vertices in the middle of a row. Once you grab a vertex that runs along the middle of the head, use the side view to drag it out, creating a rounded edge. Also, pull up some of the lower exterior vertices to form the outline of a jaw. Finally, you may want to connect some edges on parts of the model that have kinks or creases. I found that it was helpful to connect the upper exterior vertex on the eyes to the edge of the upper cheek to smooth that area out a bit.

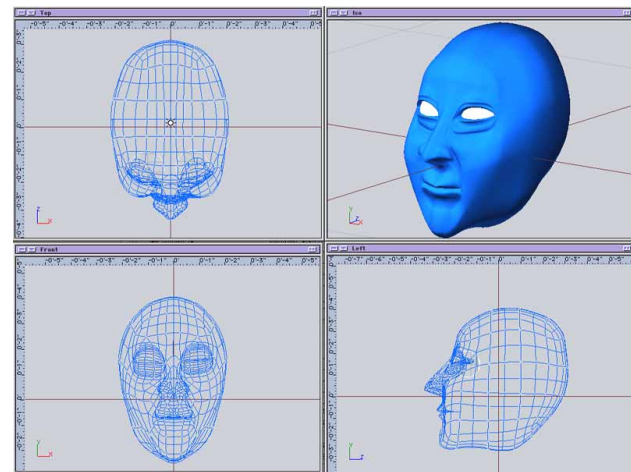


Figure #26

He'll still look a little strange without ears, hair and a neck, but the final results should look something like [Figure 26](#).

Ears

Finally, let's add ears to our model. In order to keep the head model as simple as possible and because the ears will never really be affected by any facial animation, we'll create the ears as separate UN elements. If necessary, we can always join the ears with the head later.

Create a block primitive roughly where one of the ears will go. Use the UN tool to convert the primitive to a UN shape. Do one global subdivide on the new UN shape. Next, using an image as a template, or sculpting visually, construct a profile of the ear in the side view. You might want to add an extra rib in the Side view to create the lower bulge in the lobe (see [Figure 27](#)). Next, we'll construct the bulge along the outer lobe. The bulge starts on the upper inner portion of the ear and travels along the outside edge,

until it blends in with the lower lobe. To create this, we'll want to only work on the outer facing section of the ear.

- ♦ In the Front view, using the **visibility** tool, make sure only the exterior facing edge of the ear is visible. Next, in the side view, use the delete edge tool to delete all of the interior edges on the front of the ear. At this point, you should only have edges around the outside of the ear and a single loop center in the middle.

Now we'll use a few more new tools before we're all done. First, we'll use the inner border tool to create a new set of edges that run alongside the interior of the ear.

- ♦ Select the **inner border** tool and click on the loop center. This will create a new interior set of edges that we'll use to define the upper extrusion of the ear lobe bulge. Then, click on the new loop center with the inner border tool one more time. This second set of edges will be pushed in to define the inner edge of the bulge. In the Side view, move your new vertices toward the outside

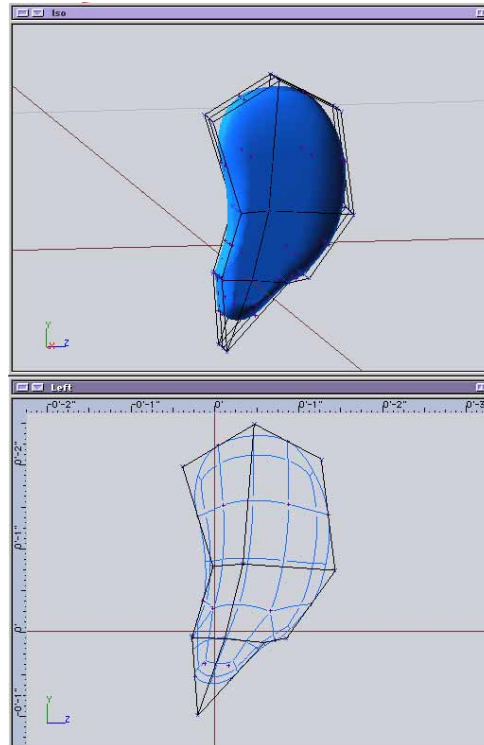


Figure #27

edges of the ear until you have something like [Figure 28](#).

At this point, you should have 3 sets of edges around the exterior of the ear.

- ♦ Pull the vertices from the middle set of edges out on the x-axis to create the lobe bulge. Pull the edges out more broadly at the base to create a flatter bulge at the bottom of the ear (see [Figure 29](#)).

Next, we need to add the inner ear bone that extrudes out from the middle of the ear. Once again, using the inner border tool, we're going to create a series of inner edges to define the protrusion. This time we'll need 3 new sets of inner edges; 2 on the outside to define the base of the bone and one in between to define the protrusion.

- ♦ Using the **inner border** tool, create 3 new inner border loops from the center. Arrange the new set of edges until they form a ridge shape for the ear bone. Since the ear bone only sticks out on the outer part of the ear, you can delete all of the edges that are on the inner part of the ear, using the **delete edge** tool. Connect the loose edges remaining to the existing interior ear vertices. The final set of new edges should look something like [Figure 30](#).

- ♦ Pull out the middle set of edges in the ear bone on the x-axis until you have a nice protruded bone section. To finish off the front of the ear, we need to push a vertex in the center of the ear canal in toward the head to create a hole. There should be a loop center in the middle of the ear canal that we can use to add this vertex.

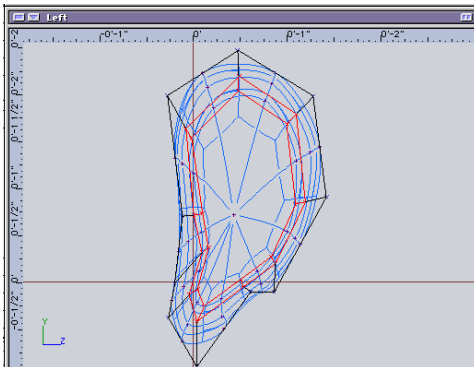


Figure #28

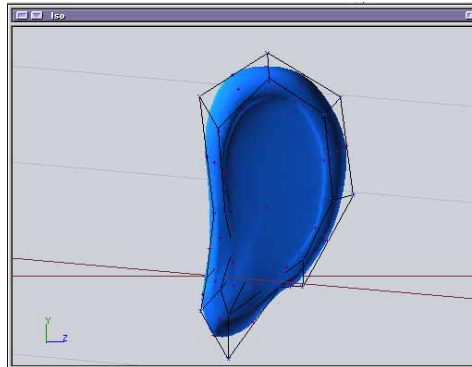


Figure #29

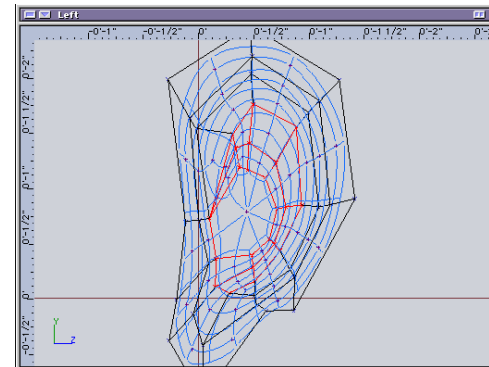


Figure #30

- ♦ Using the **subdivide loop** tool, click on the loop center. This will create a central vertex that you can then move back on the x-axis to form a hole for the ear canal. You may also want to increase the weight on this vertex to pull the hole in tighter (see [Figure 31](#)).

Finally, make the entire ear visible. Much like the final stage in building the head, you need to round and shape the back of the ear and blend it in with the detailed front area you've been working on (see [Figure 32](#)).

Once you have this basic shape down you can add little details, like the small bone that extrudes from the base and inner sections of the ear. When you're satisfied, turn the head back on and translate and scale the ear on the head, placing it roughly where the edge of the jaw ends.

- ♦ Rotate, translate, and scale the ear until the front edge barely protrudes from the head. At this point you may also want to re-enter UN edit mode and push in the front edge of the ear vertices in until it blends smoothly with the head.

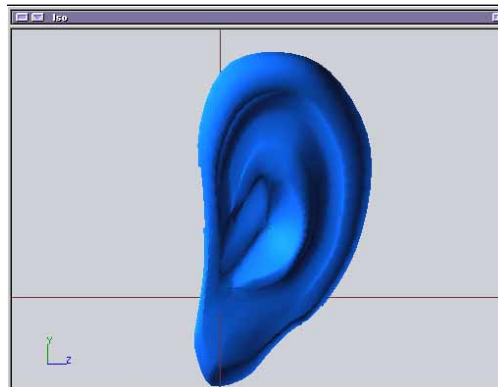


Figure #31

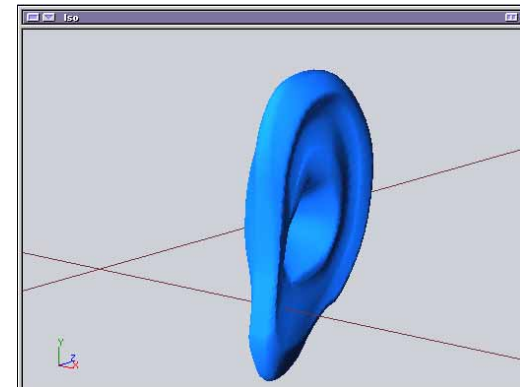


Figure #32

A portion of the head will probably extrude through the ear canal. To fix this you can add a vertex on the head and pull it inwards, or simply create a texture map later to fake it (see [Figure 33](#)).

All we need to do now is duplicate the ear onto the other side of the head. For this, we'll use the reflection tool, which creates a duplicate of the selected model, mirroring it on a line we specify.

- ♦ Select the **reflect** tool in the Transform menu palette tab. In the top view, select the ear you just created and double-click. Next, click-drag a straight line down the middle of the head and release the mouse. The ear will be duplicated to the other side of the head. If your head isn't perfectly symmetrical, you'll need to translate the ear until it's properly placed.

That's IT! You're done. You now have a workable human head that can be easily modified and animated (see [Figure 34](#)).

It may not look perfect yet, but once you add a few textures to it you'll be amazed at how much it will come to life. Like anything, practice makes perfect, and the more time you have to fine-tune the details on your character, the better it will look. Spend some time slowly increasing the level of detail using the techniques you've learned here. Add a neck and further define the jawline. Look at reference images or your own character sketches to mold the basic head we've started with into your own creation. After taking the model we created here in a few hours and spending a few weeks enhancing and fine-tuning his features I created the model shown in [Figure 35](#) for a short animation I'm working on.

I'd love to hear your feedback on this tutorial and to see the kinds of characters you come up with. Feel free to email me at ericf@dreadnought.com

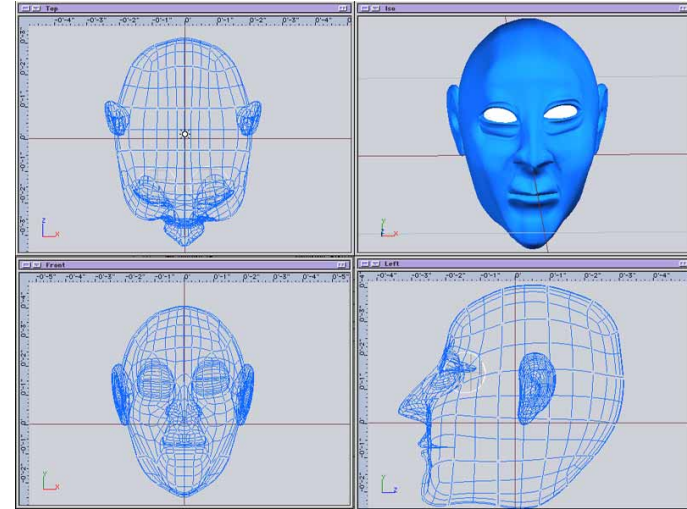


Figure #34

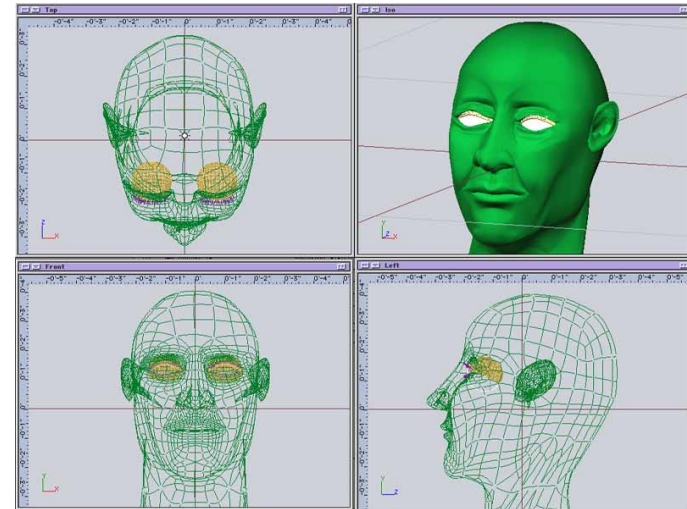
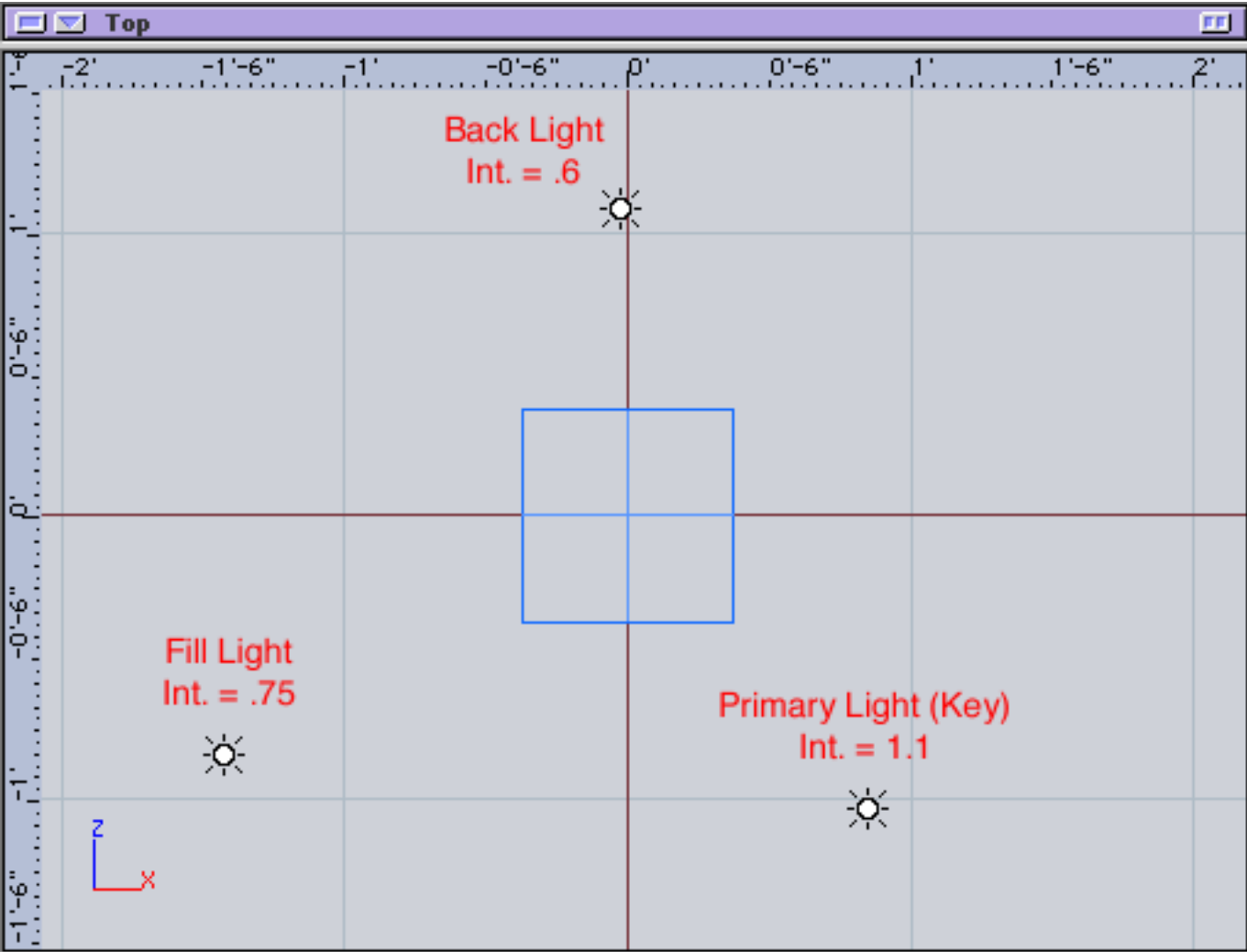
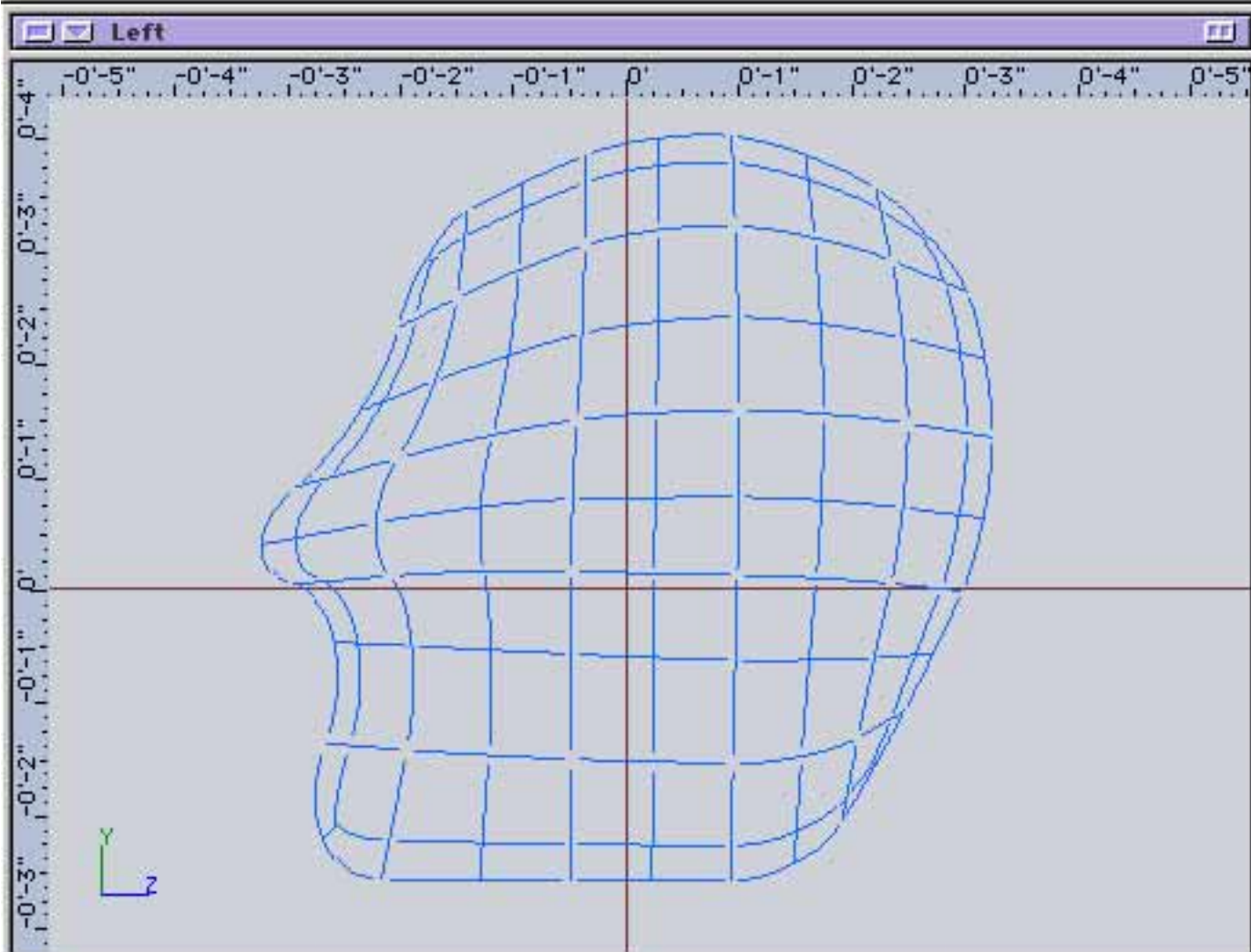
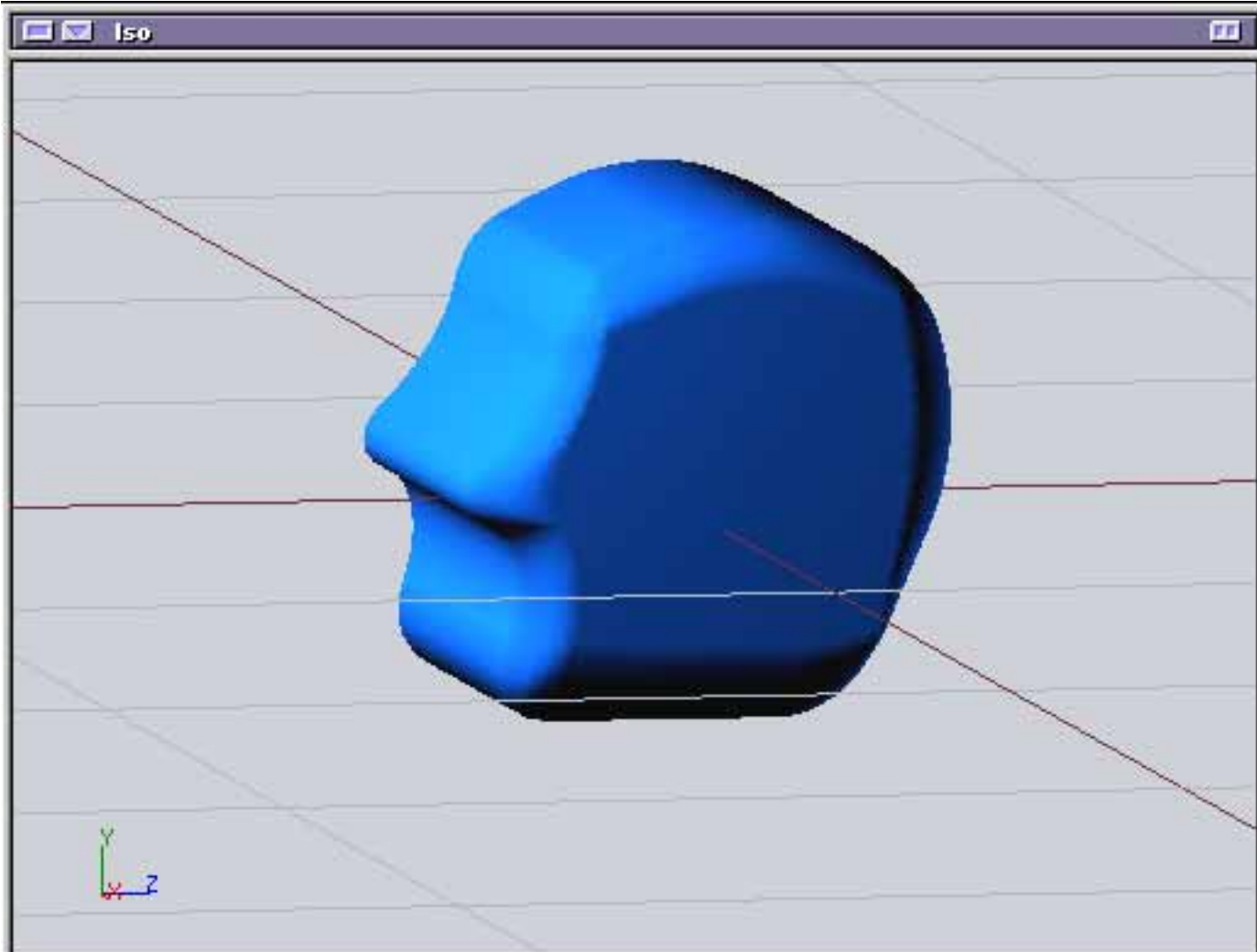
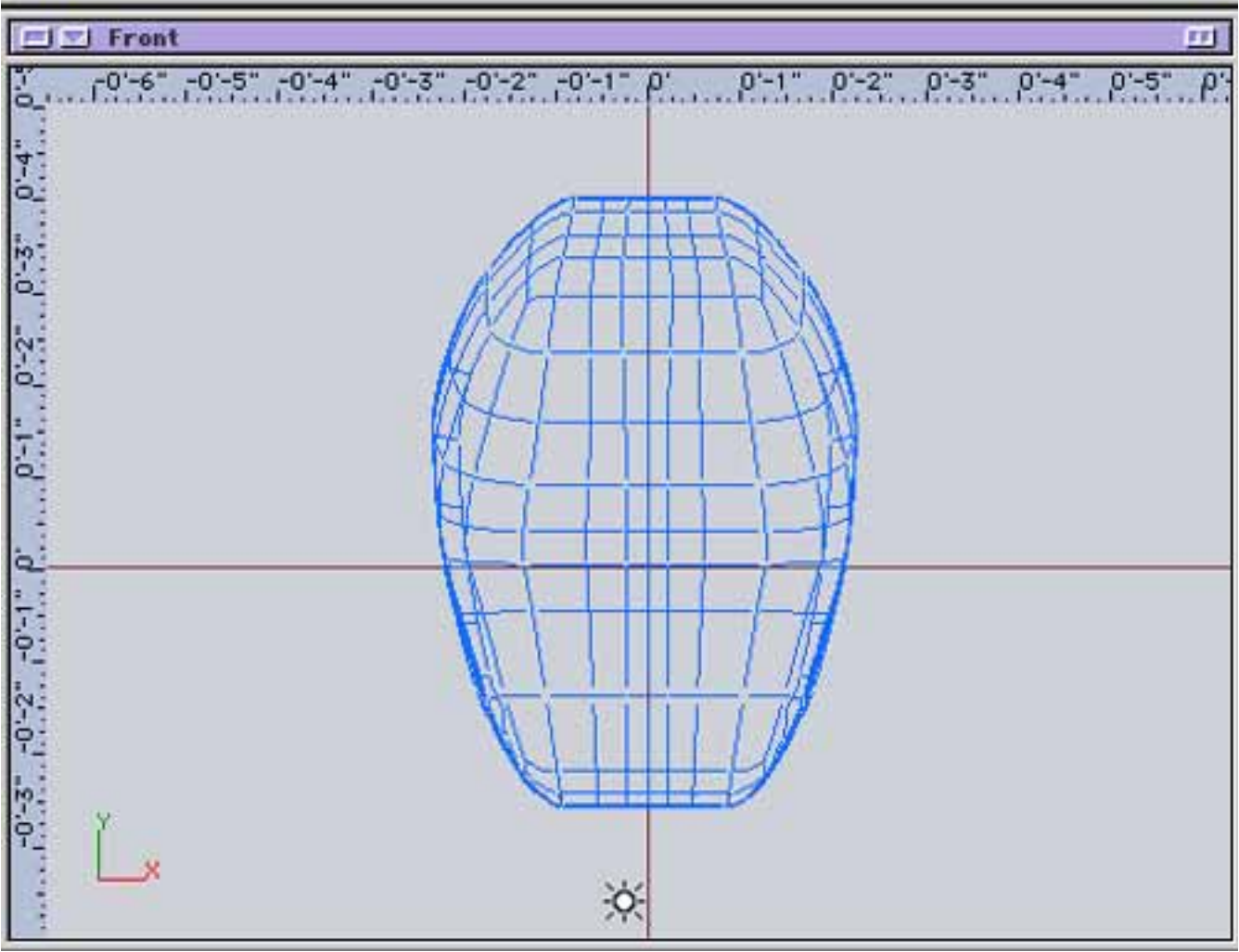
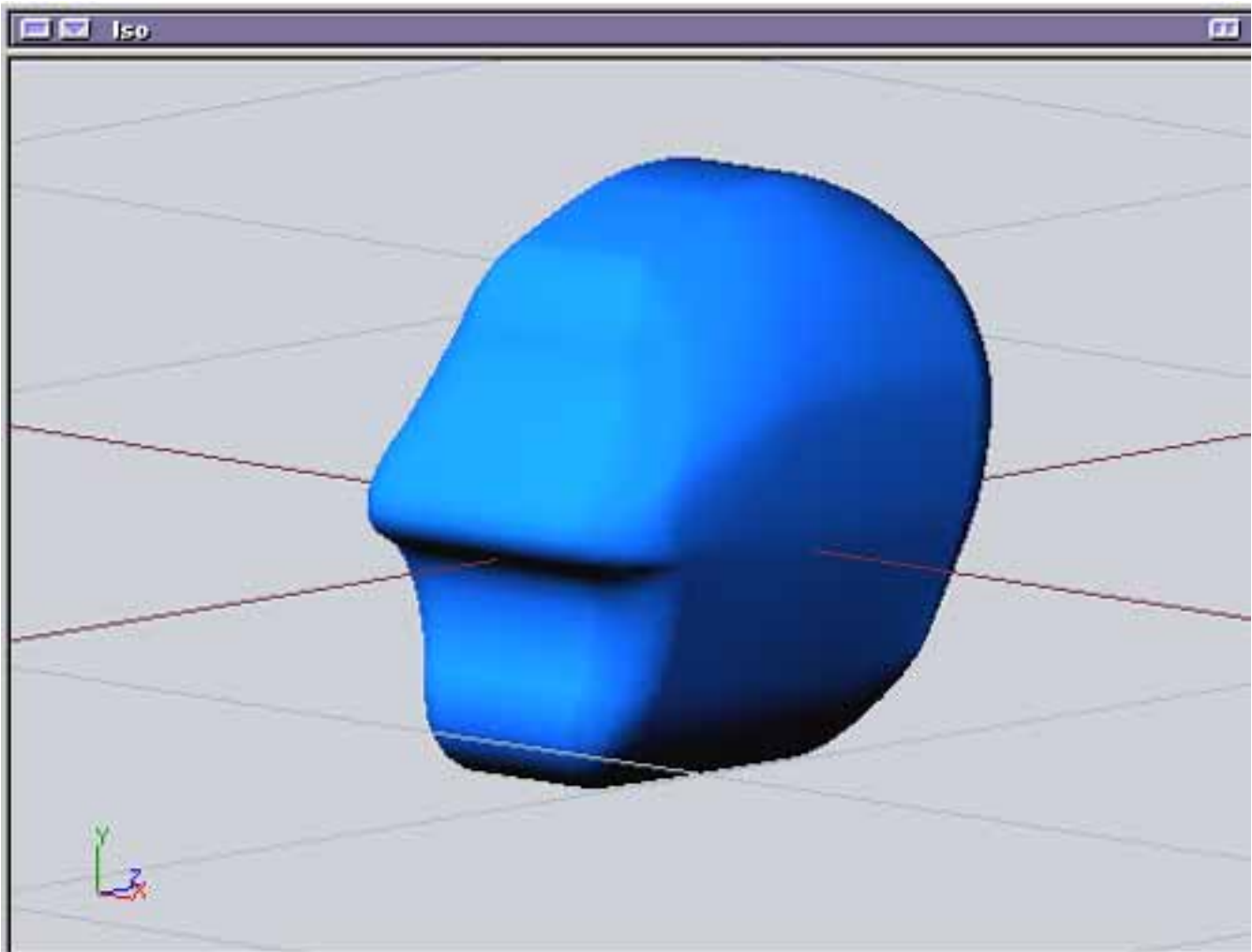


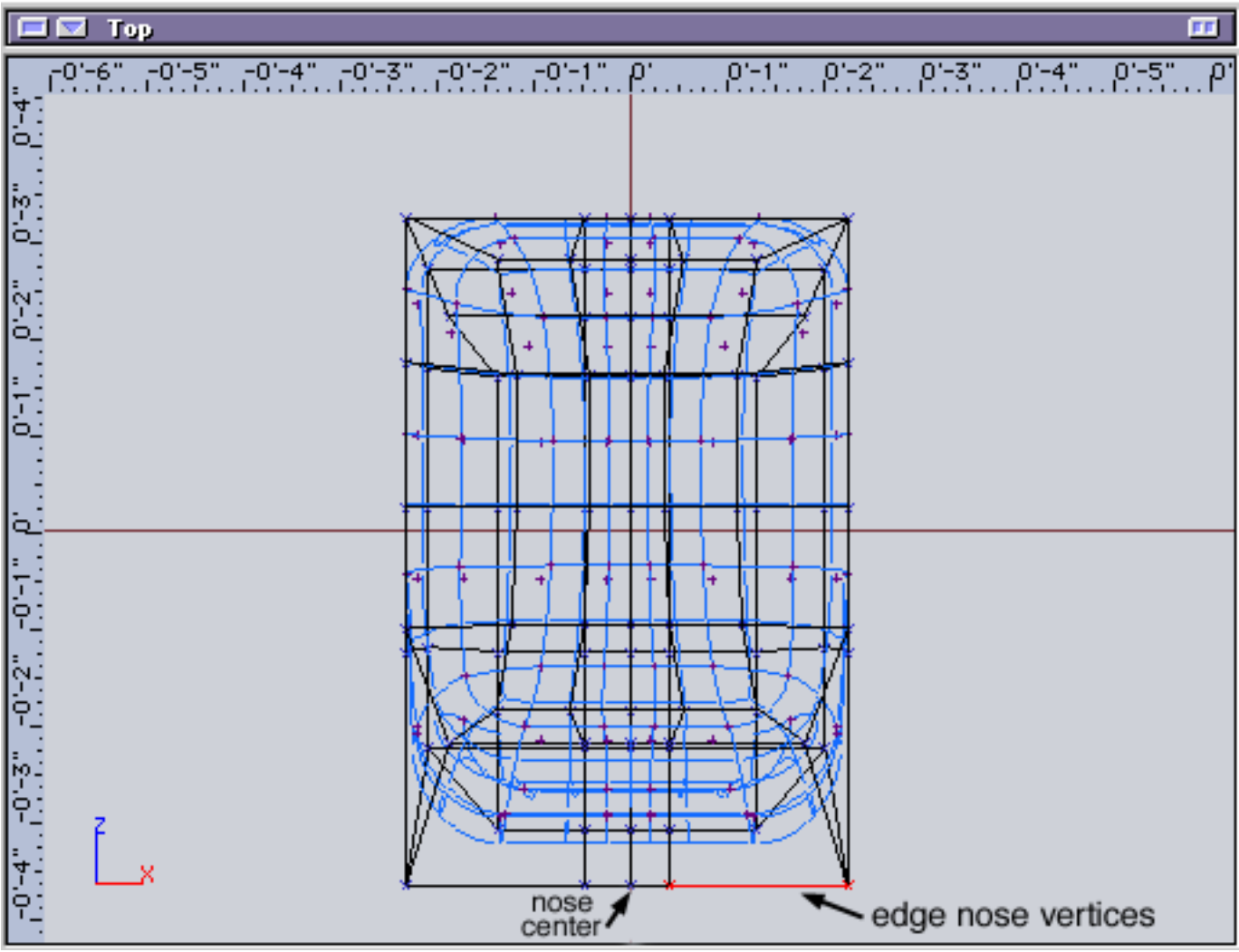
Figure #35

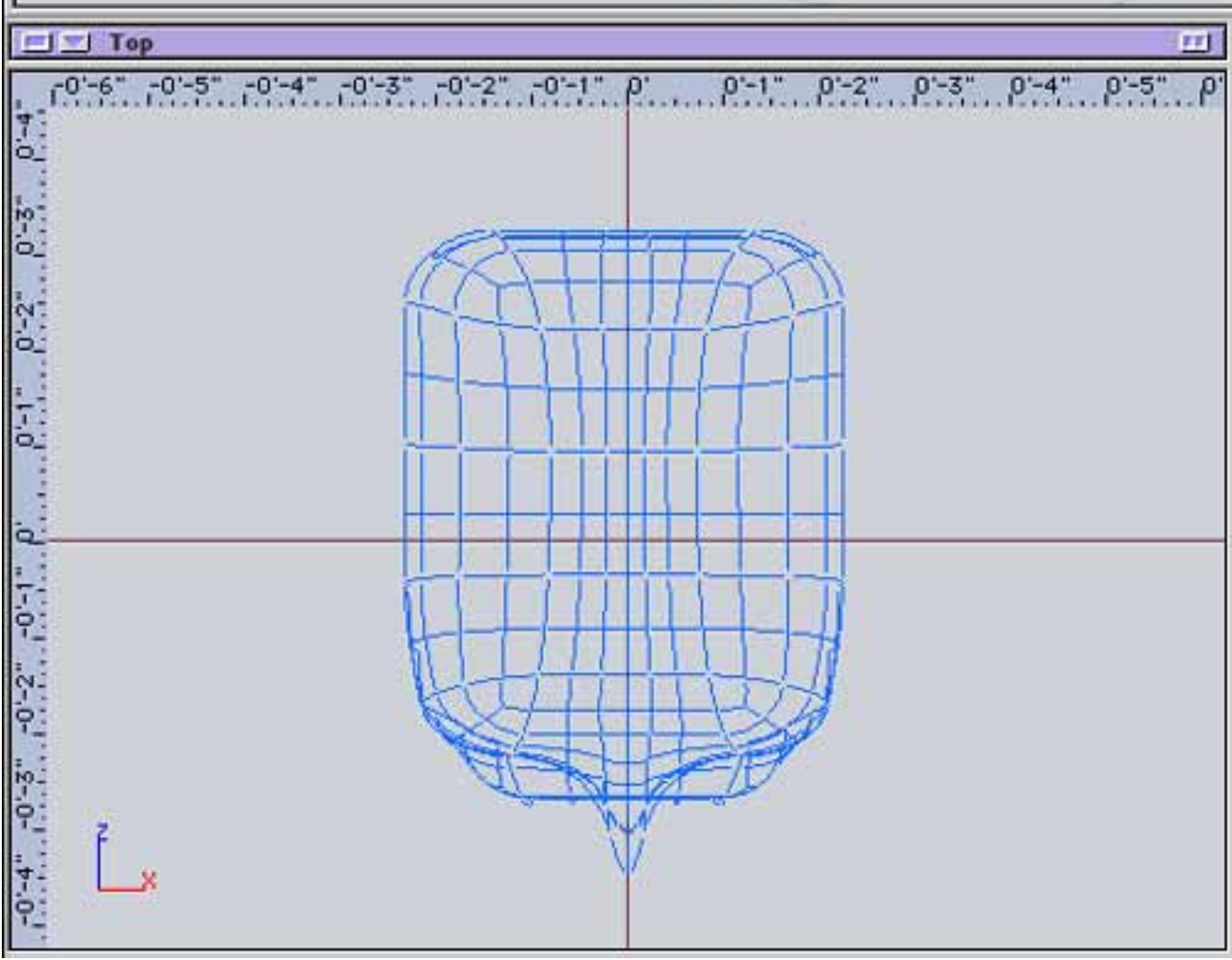
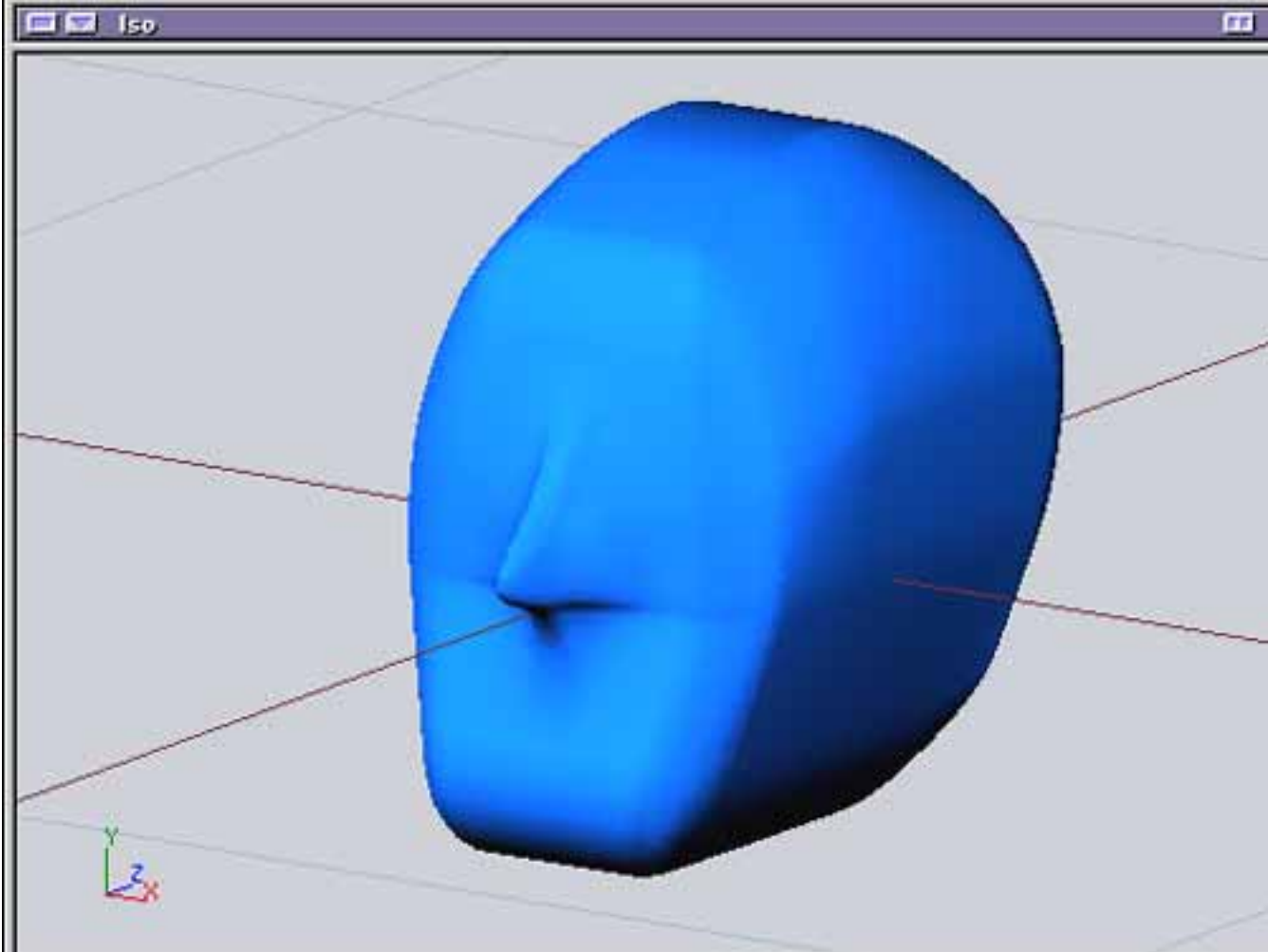


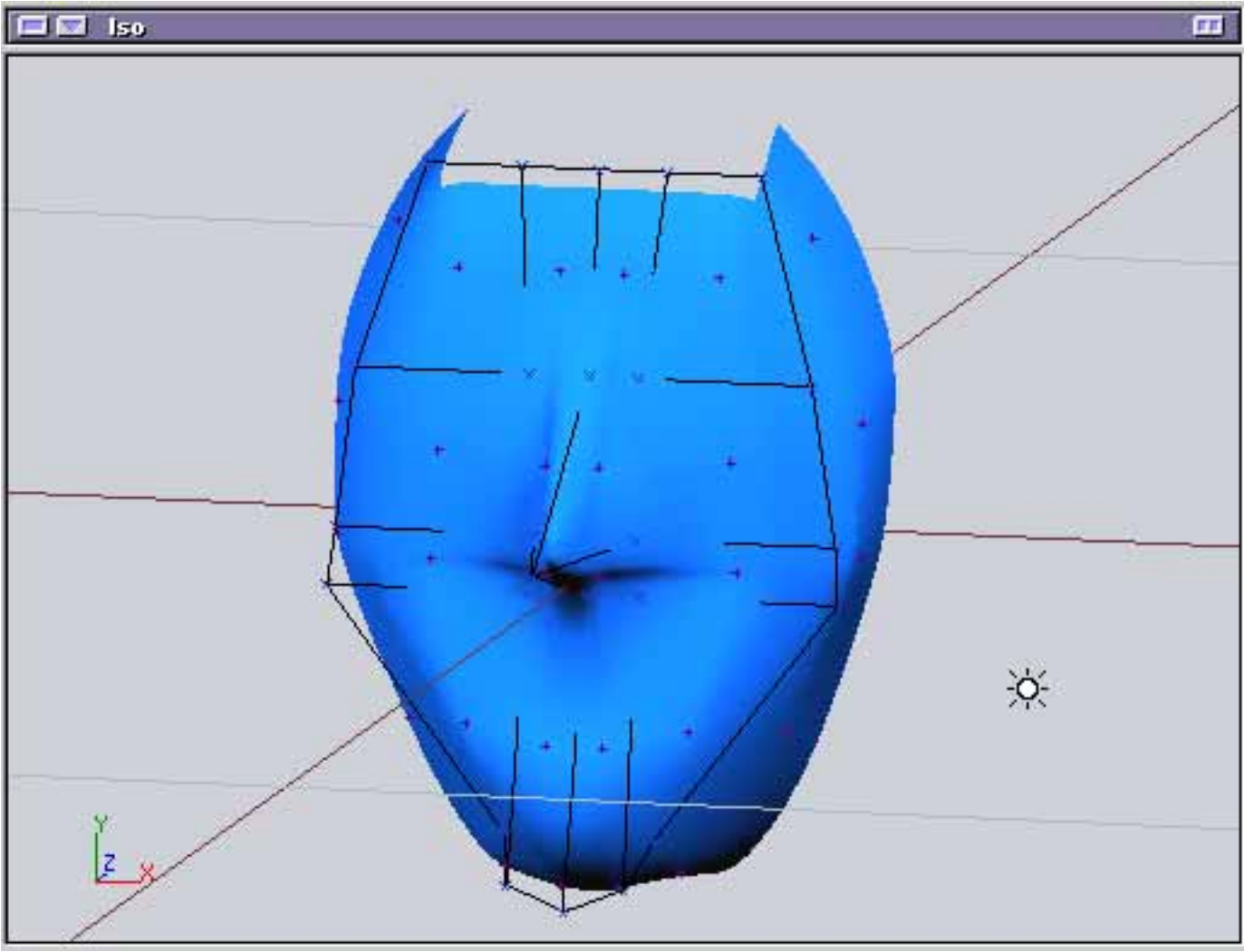


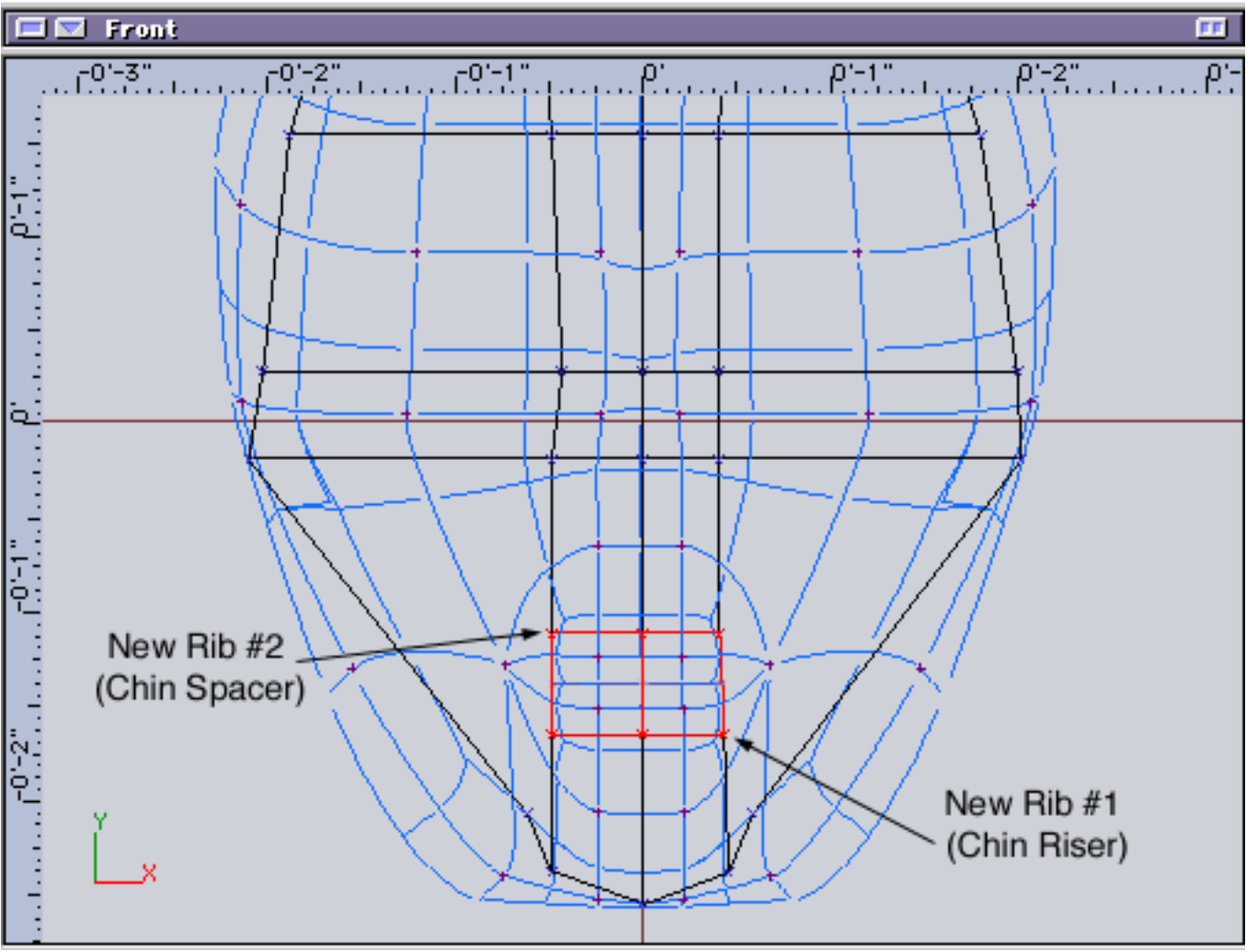








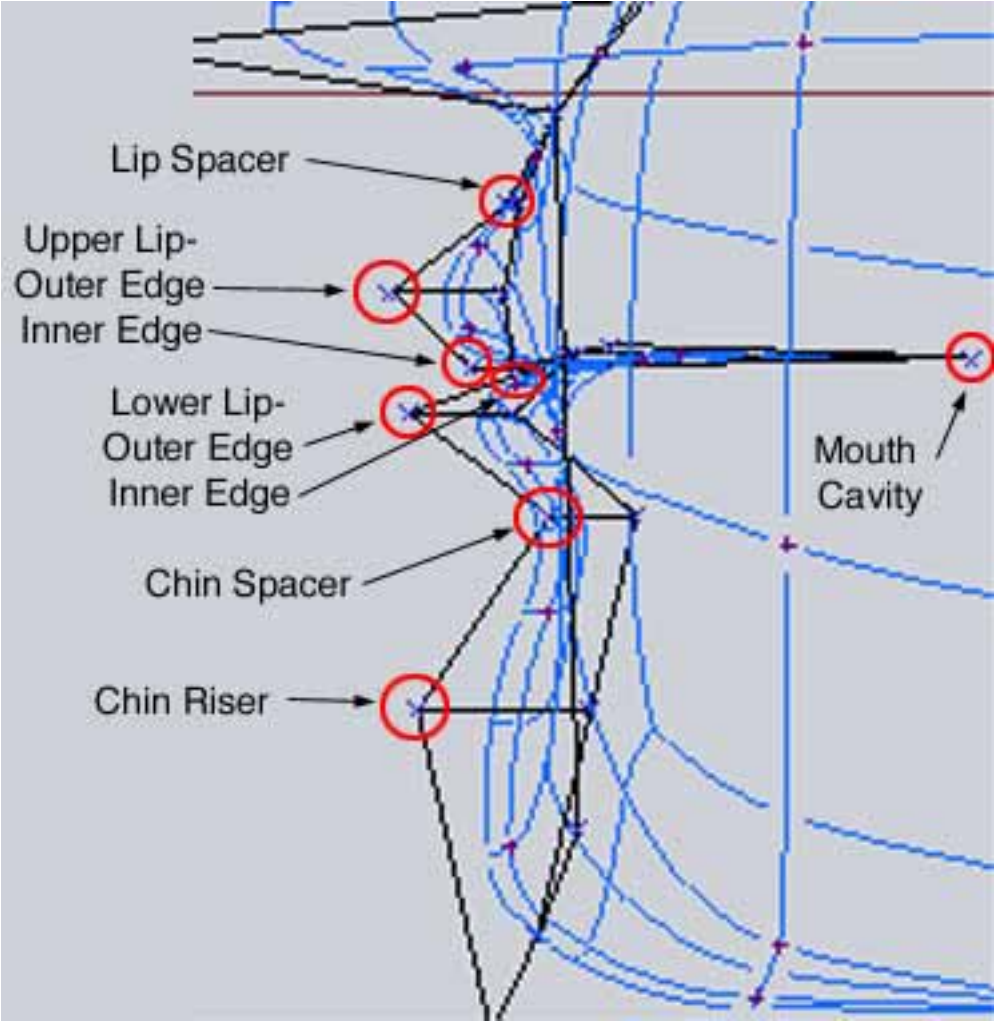


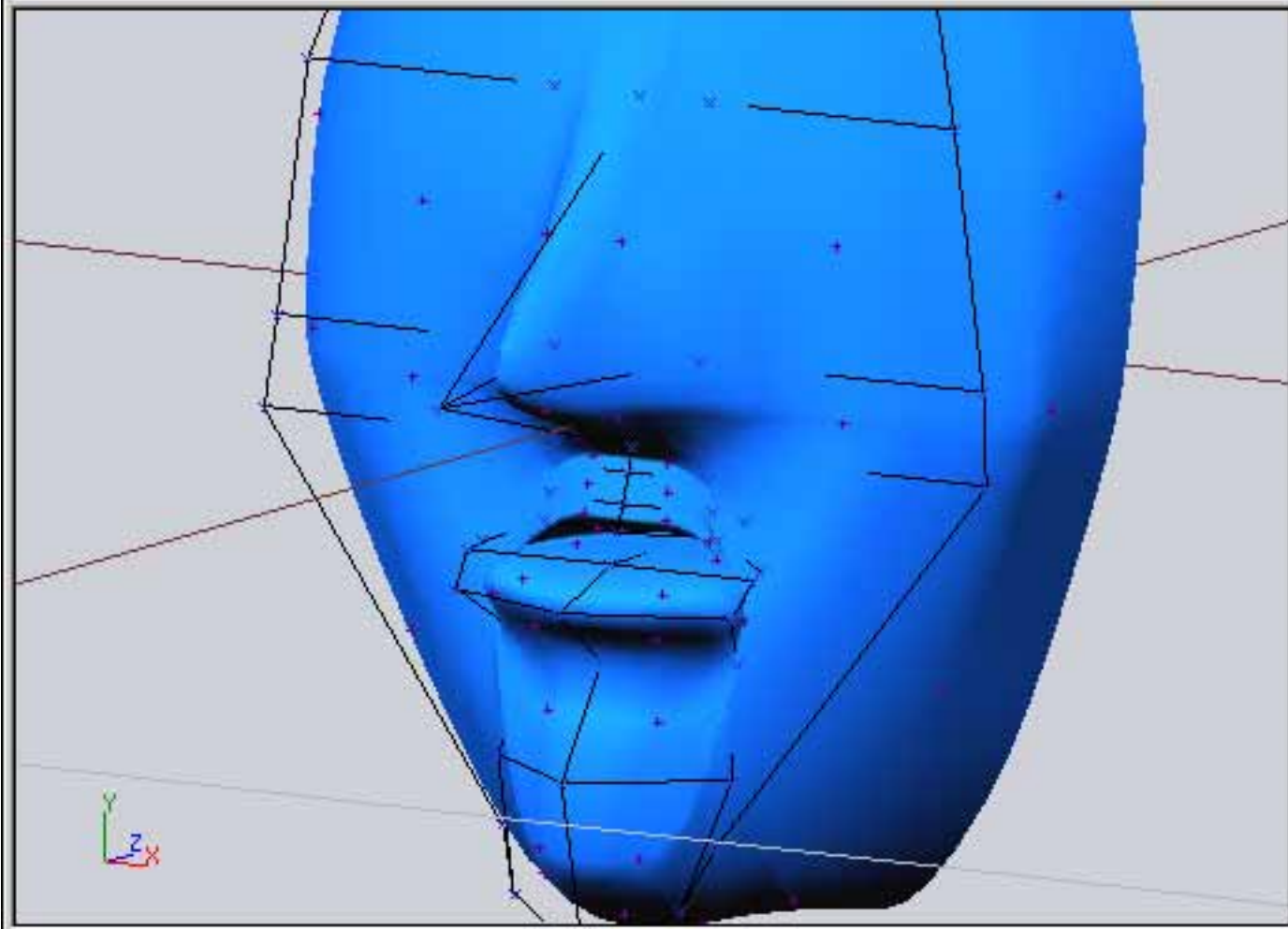


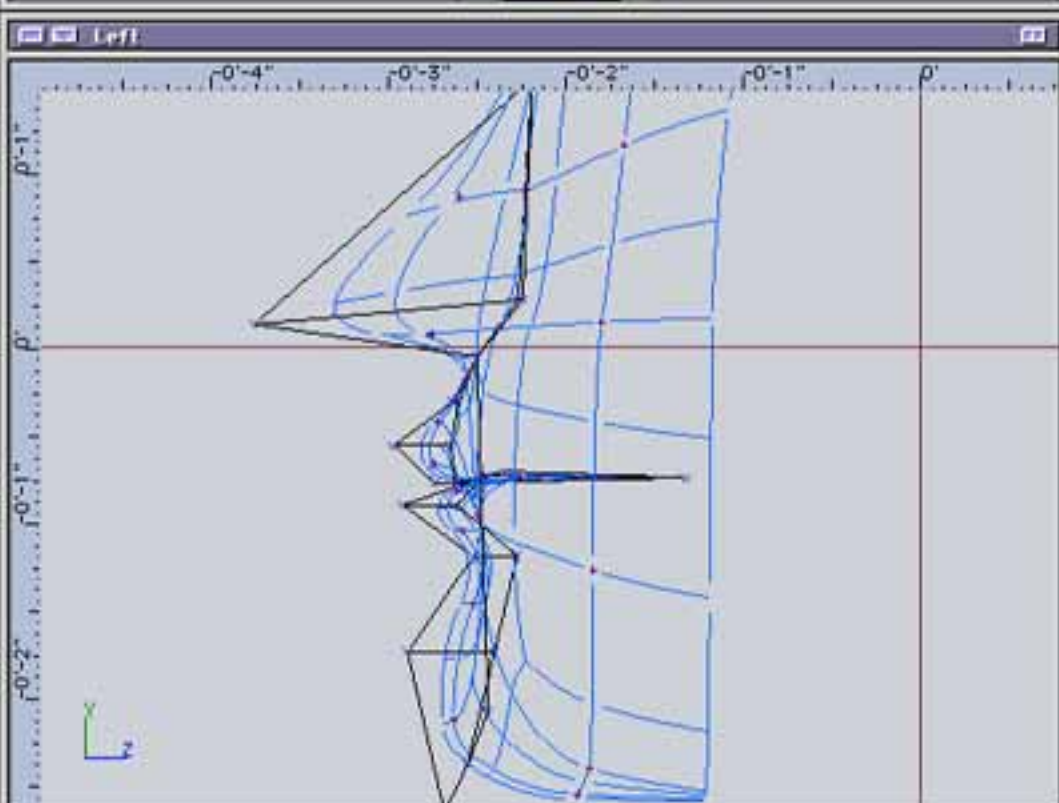
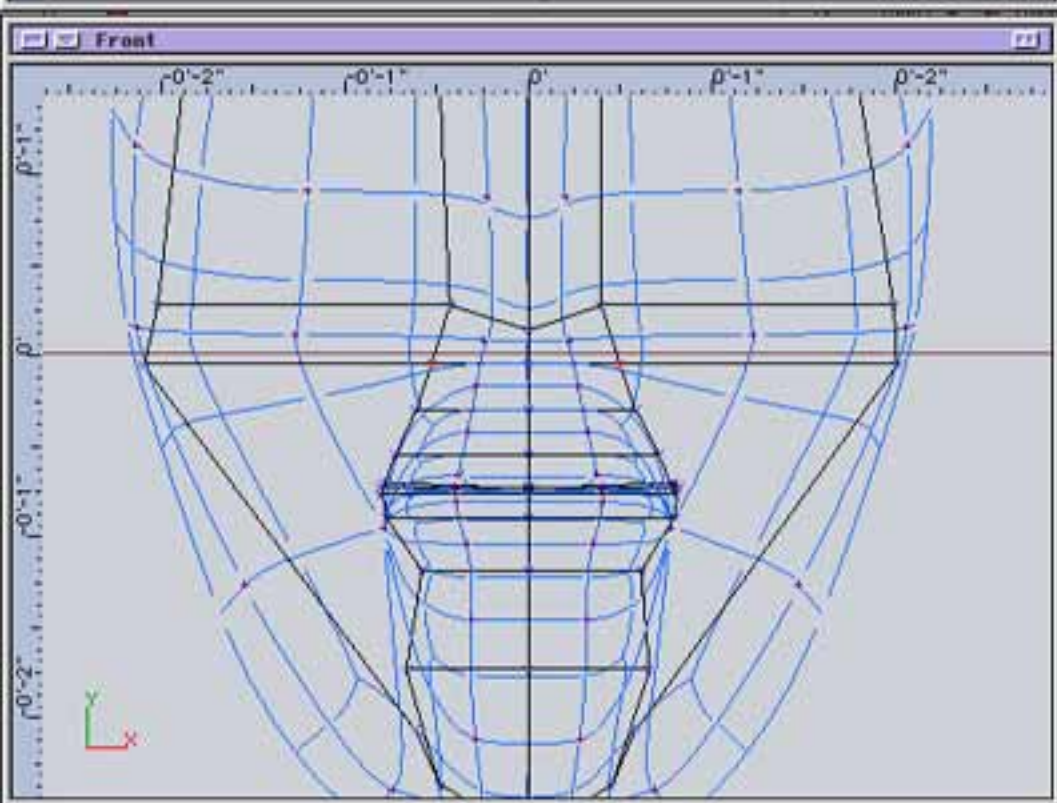
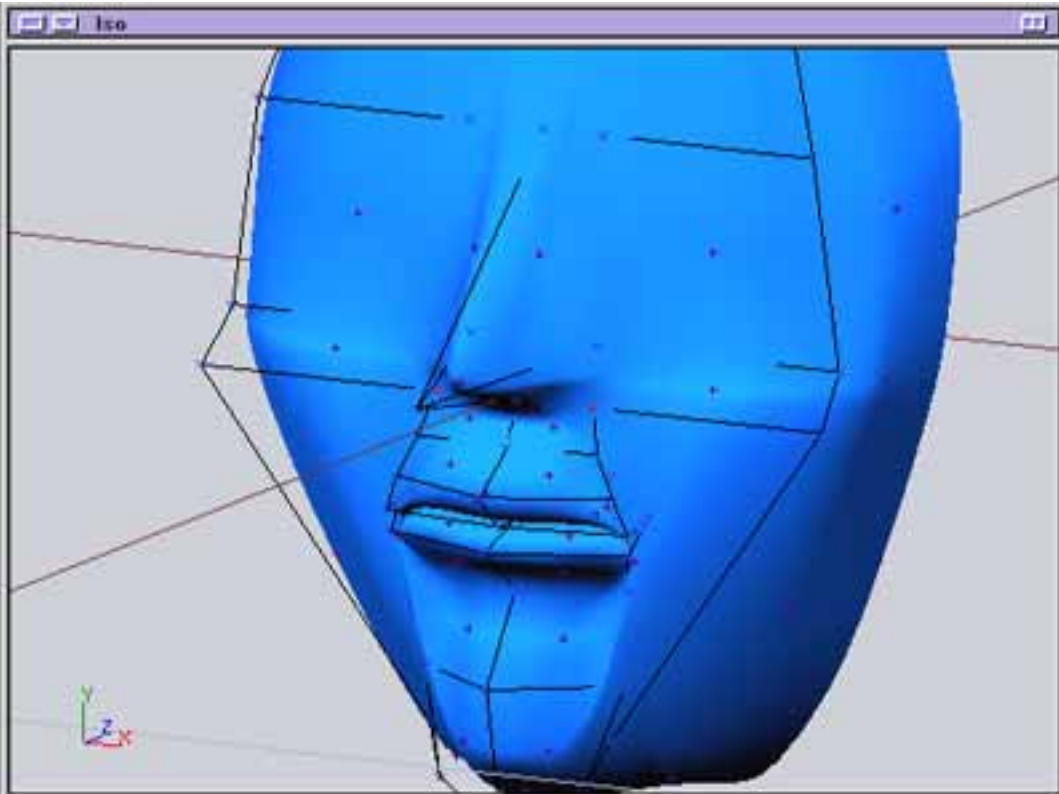
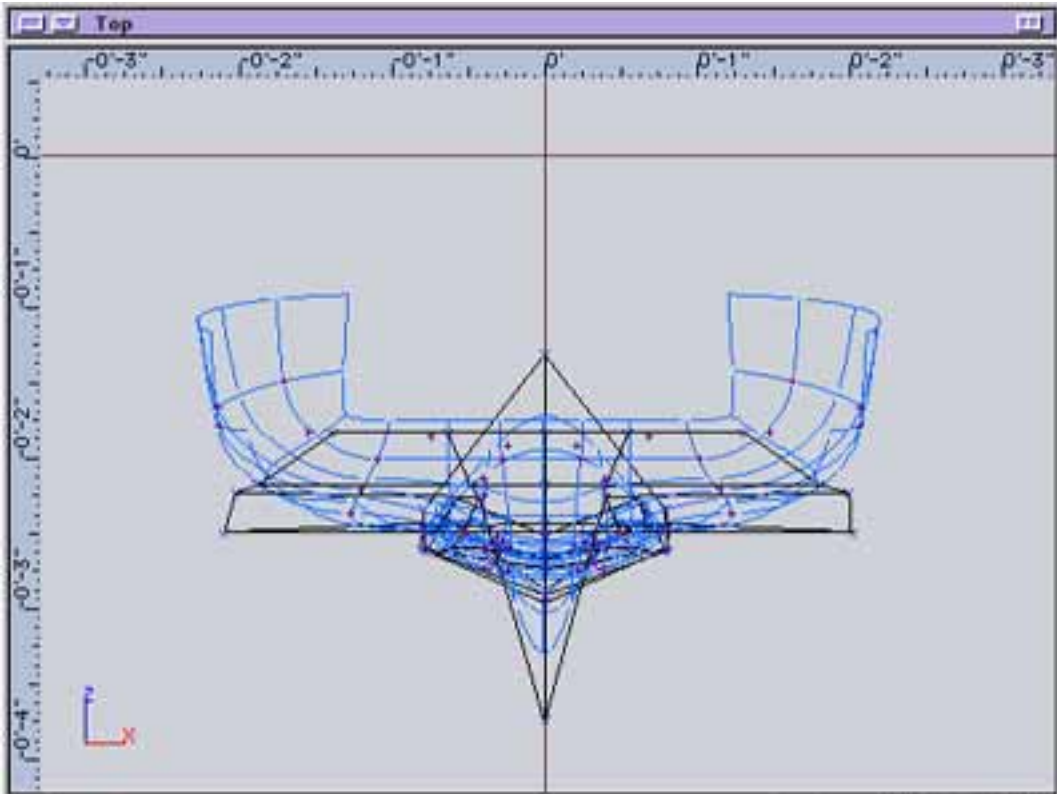
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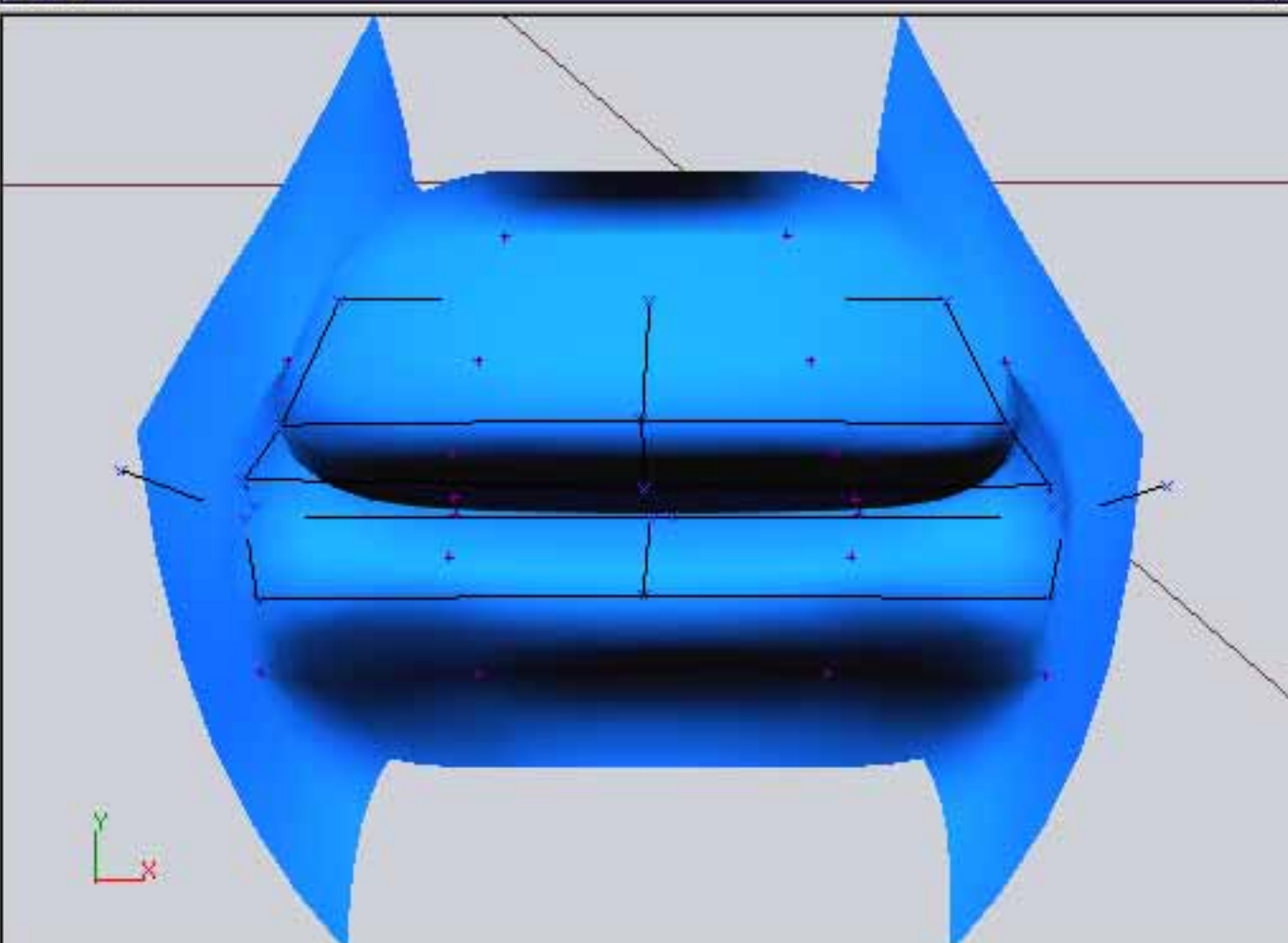
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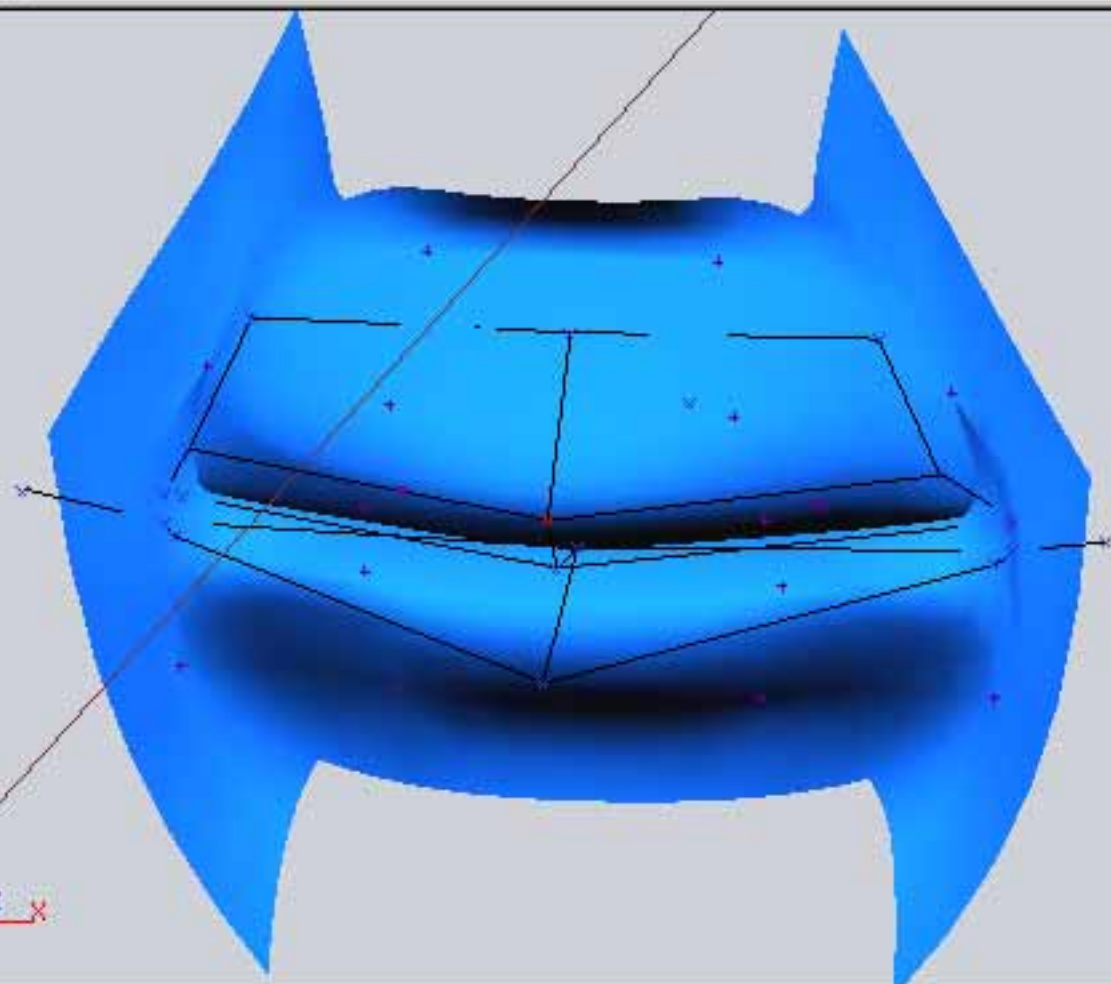


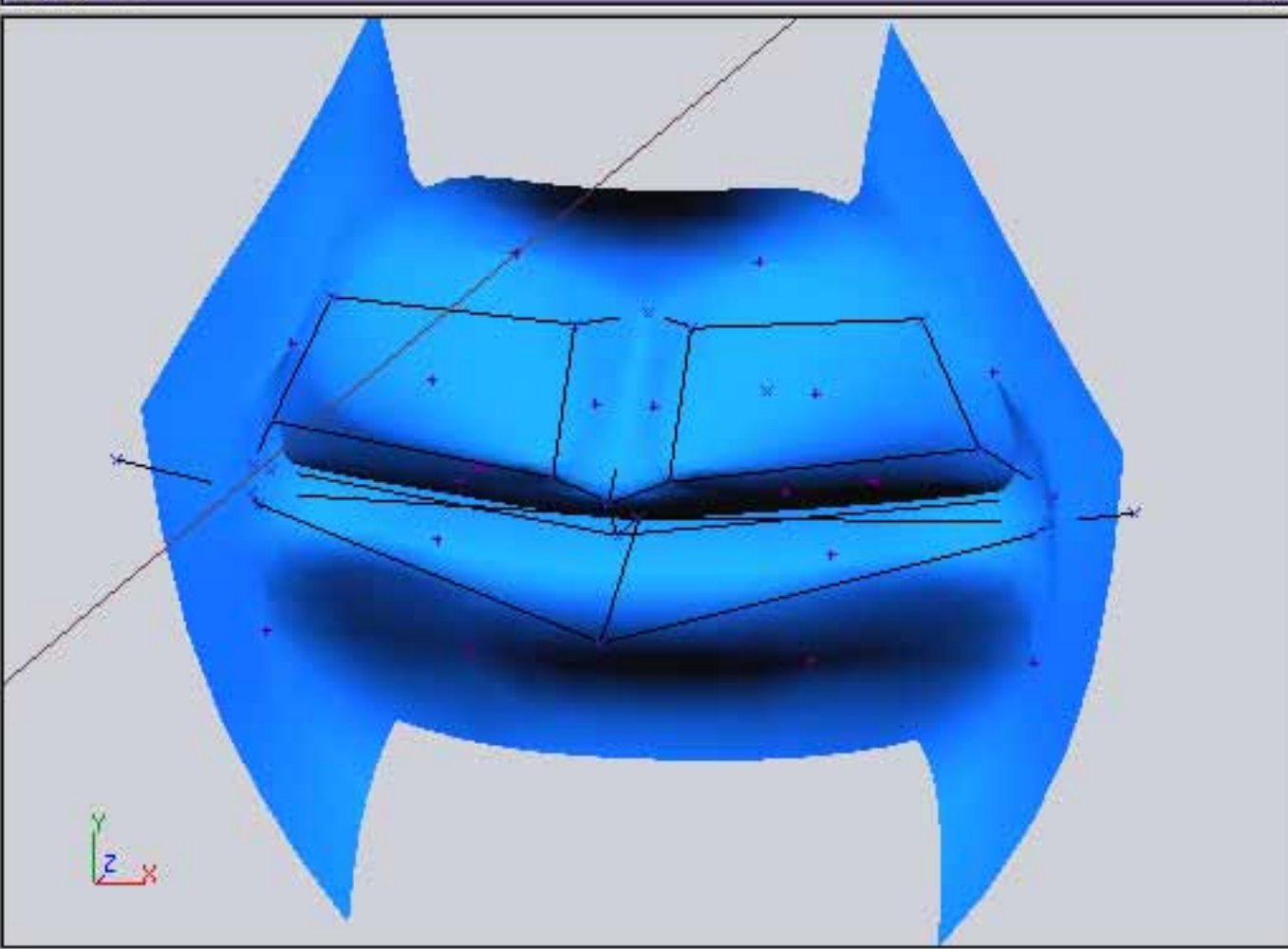


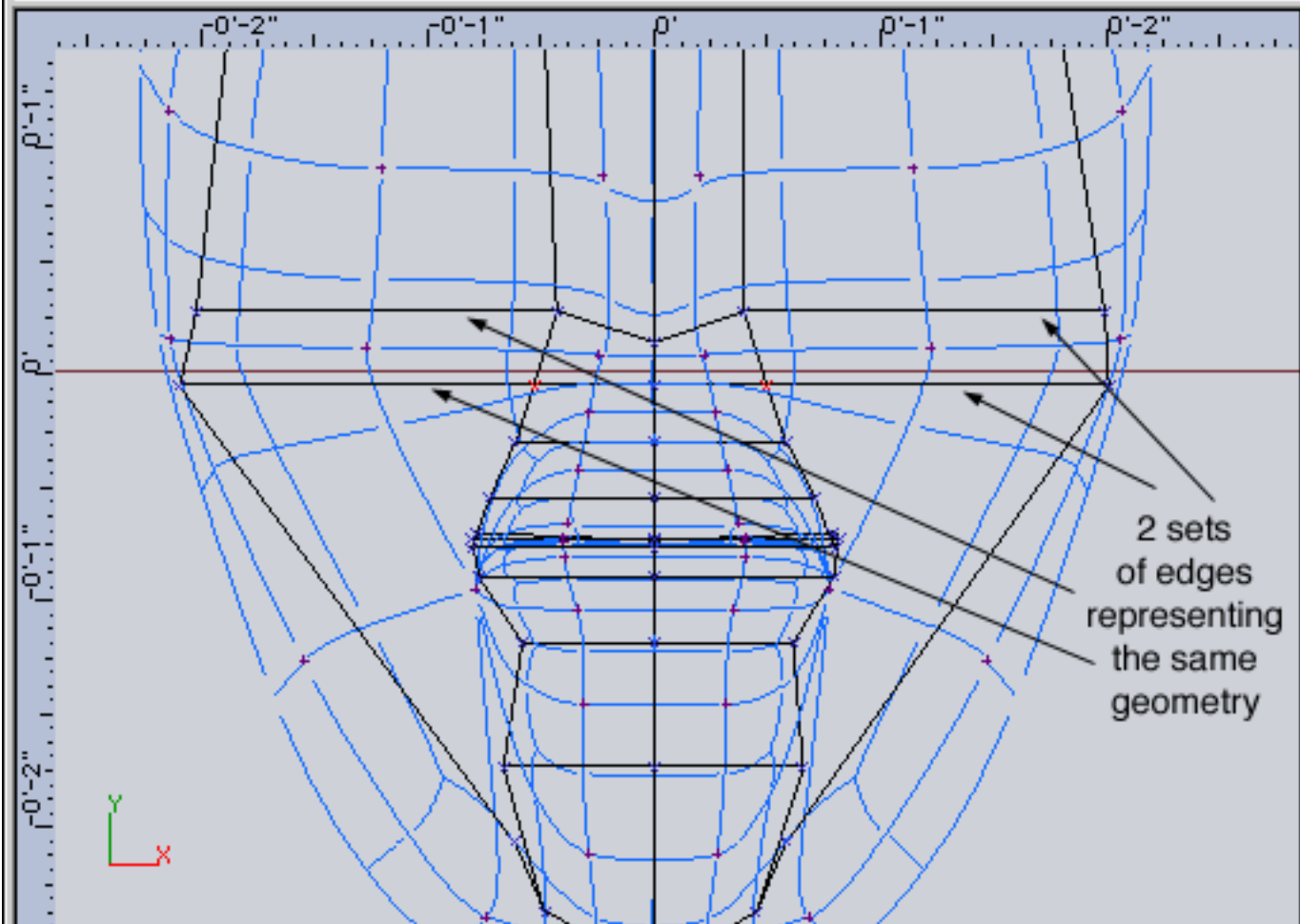


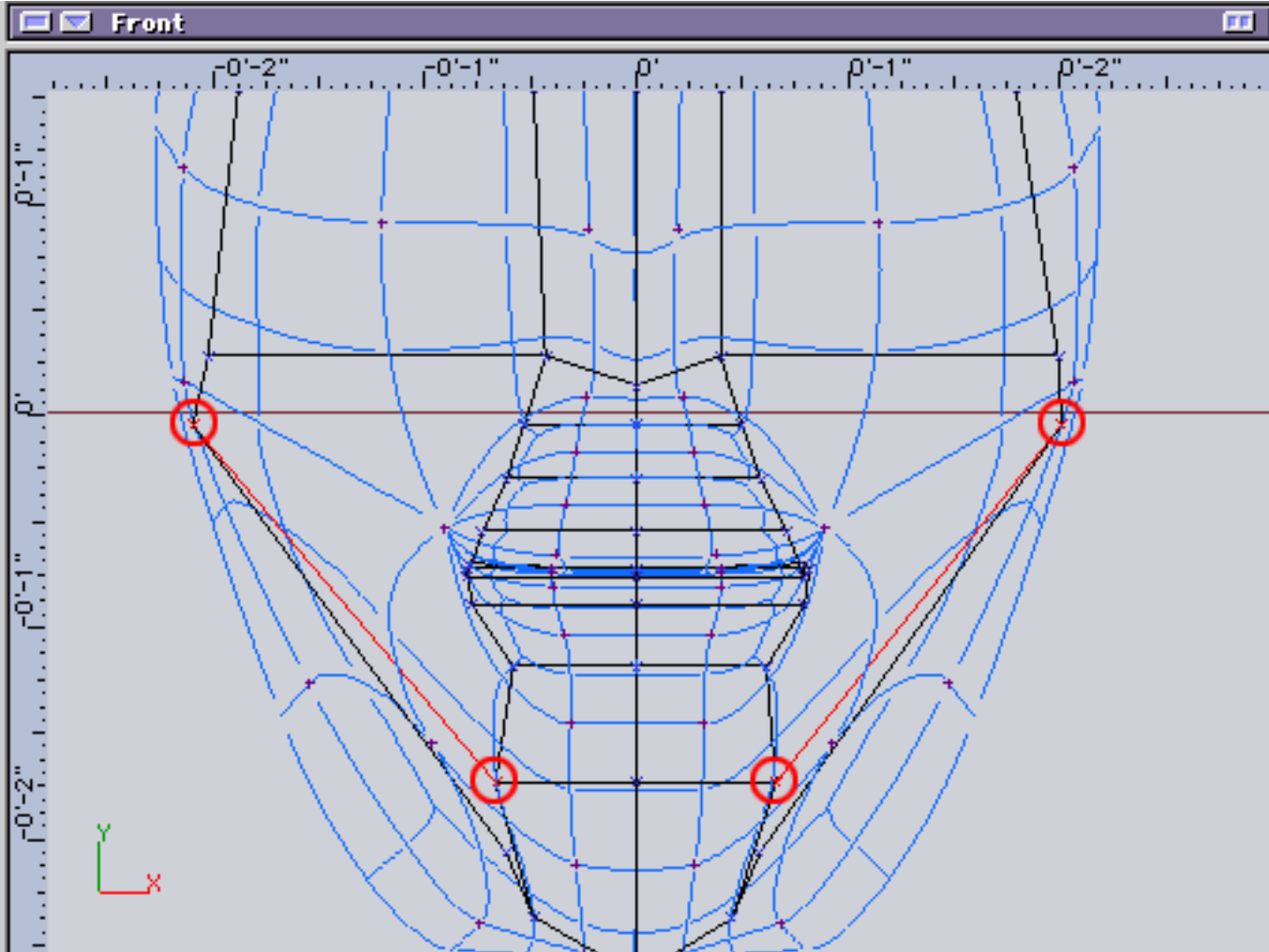


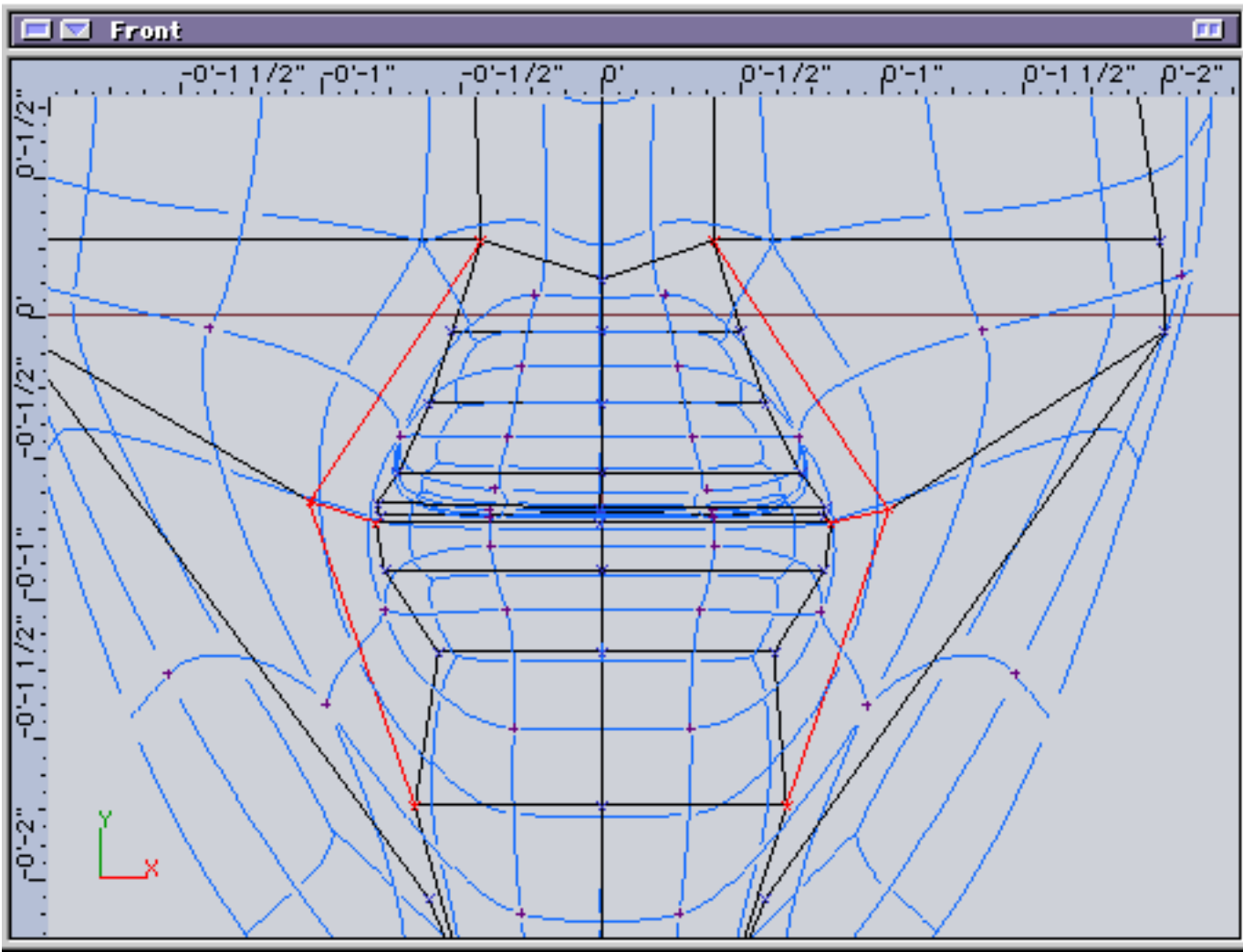




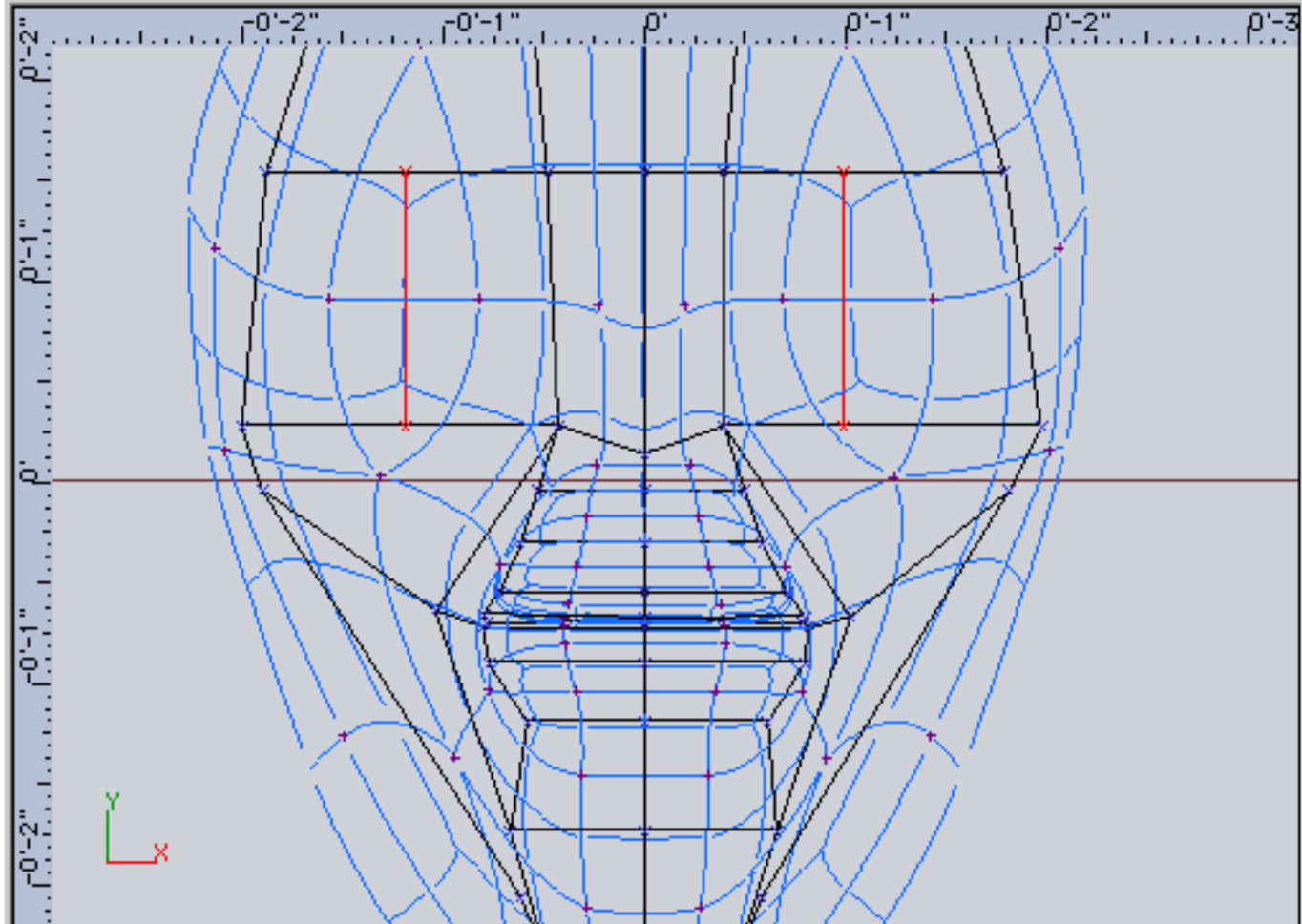


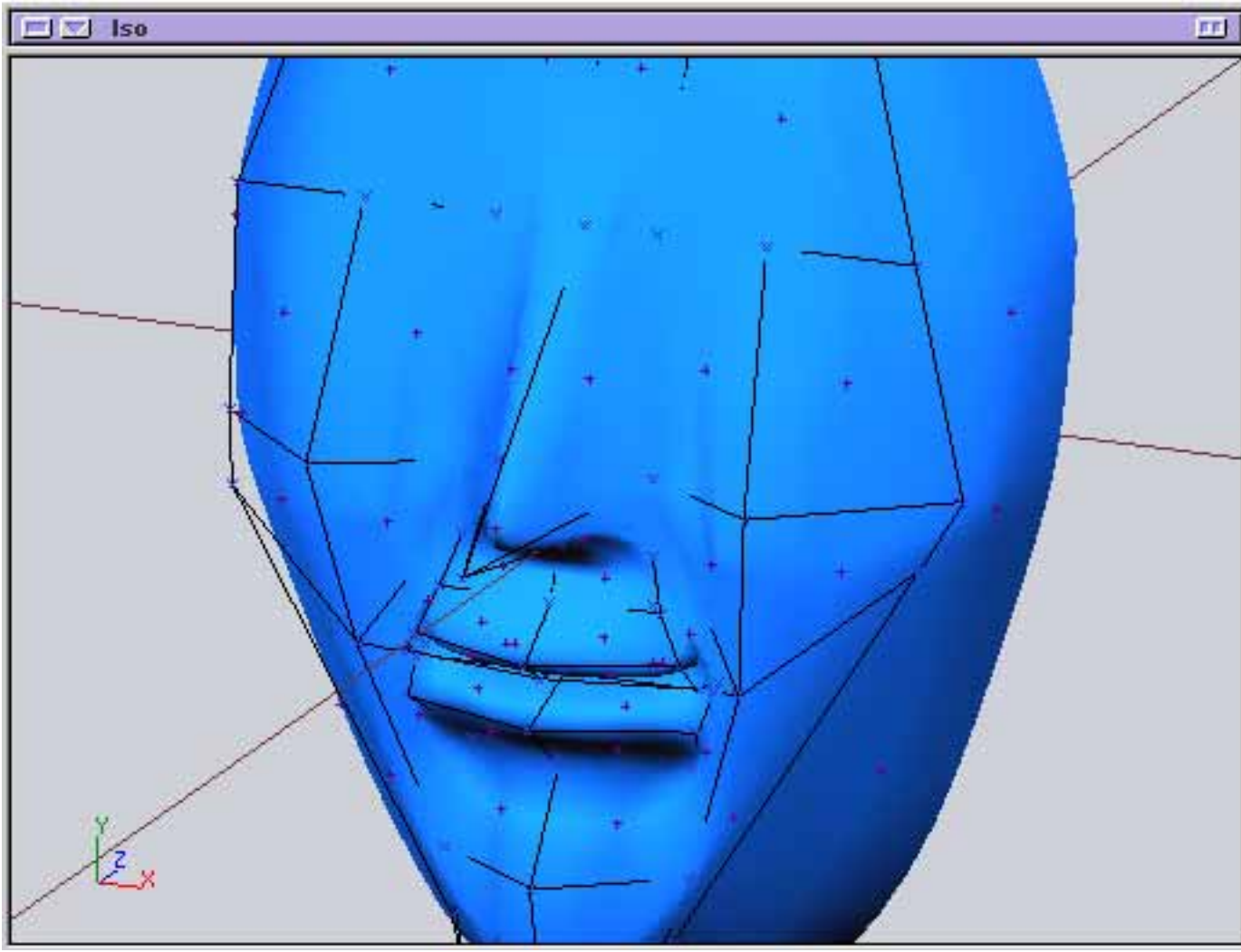


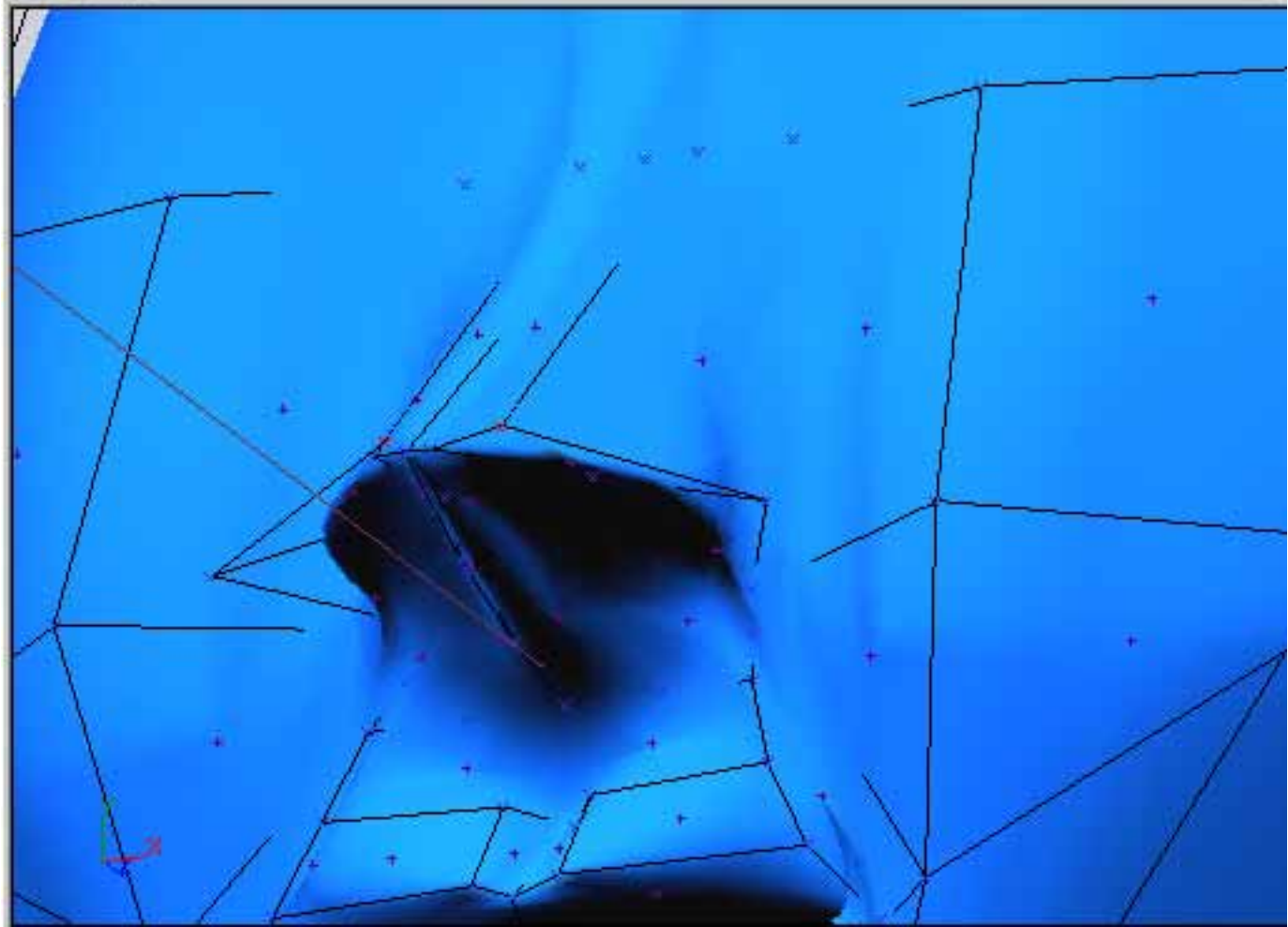




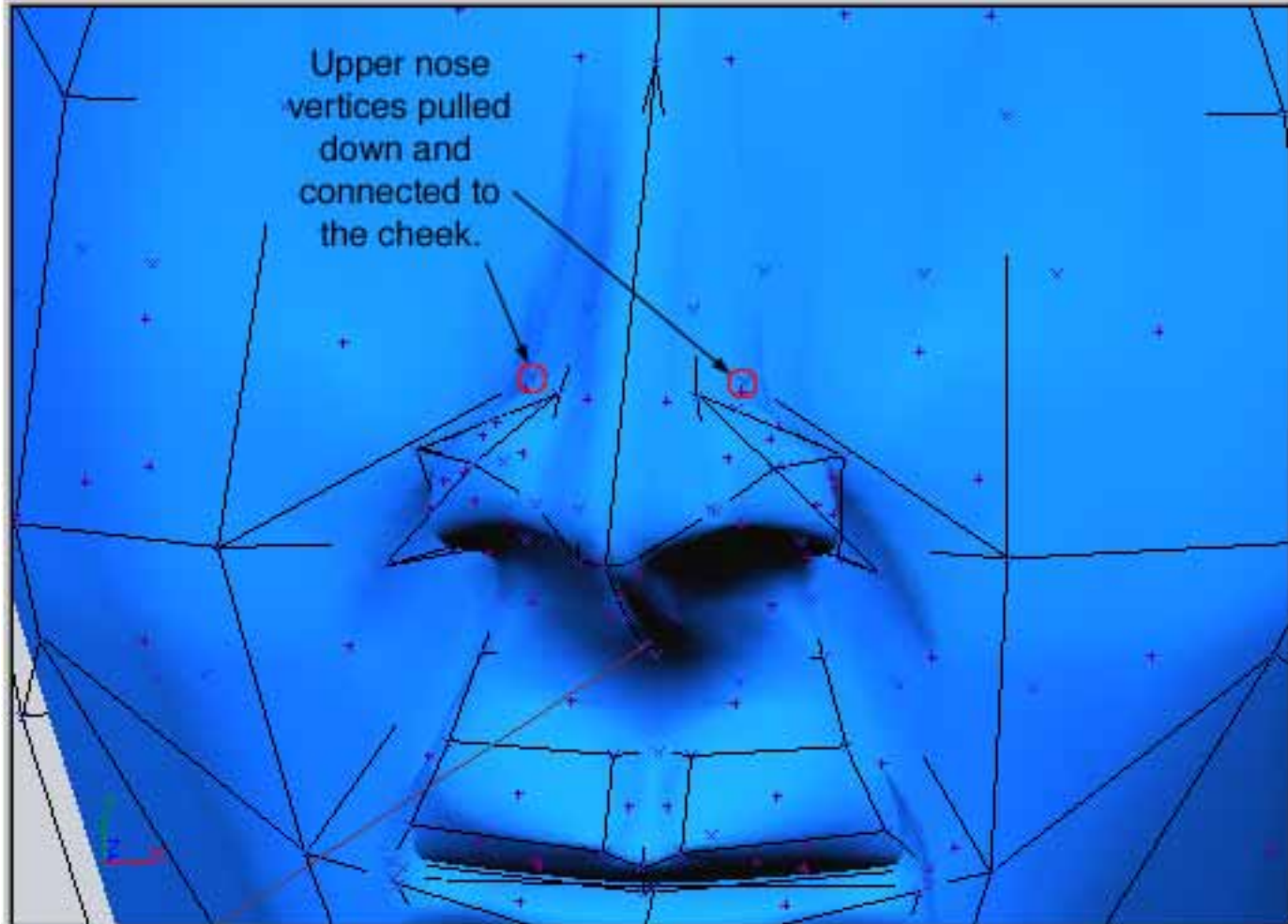
Front

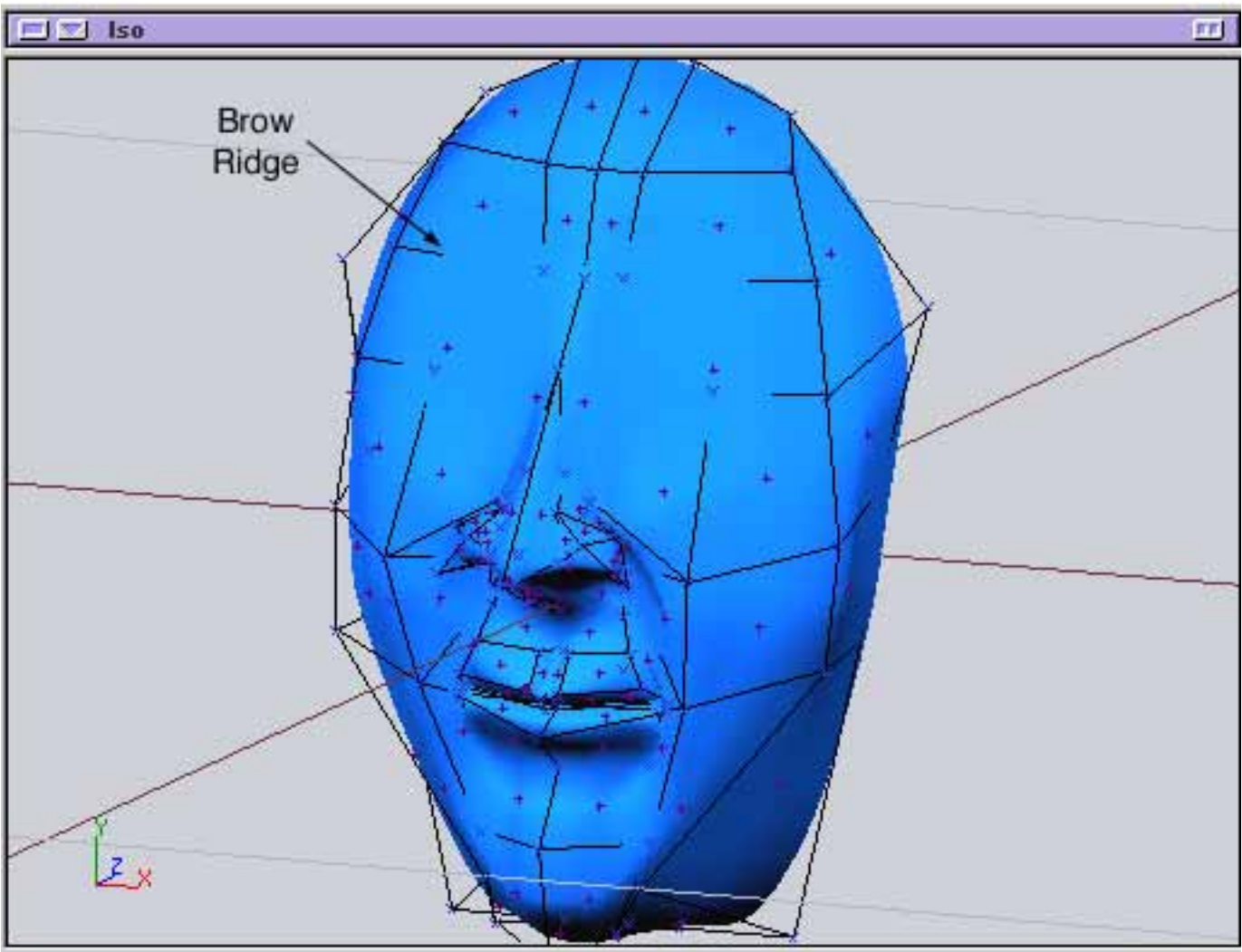






Upper nose
vertices pulled
down and
connected to
the cheek.





Front

