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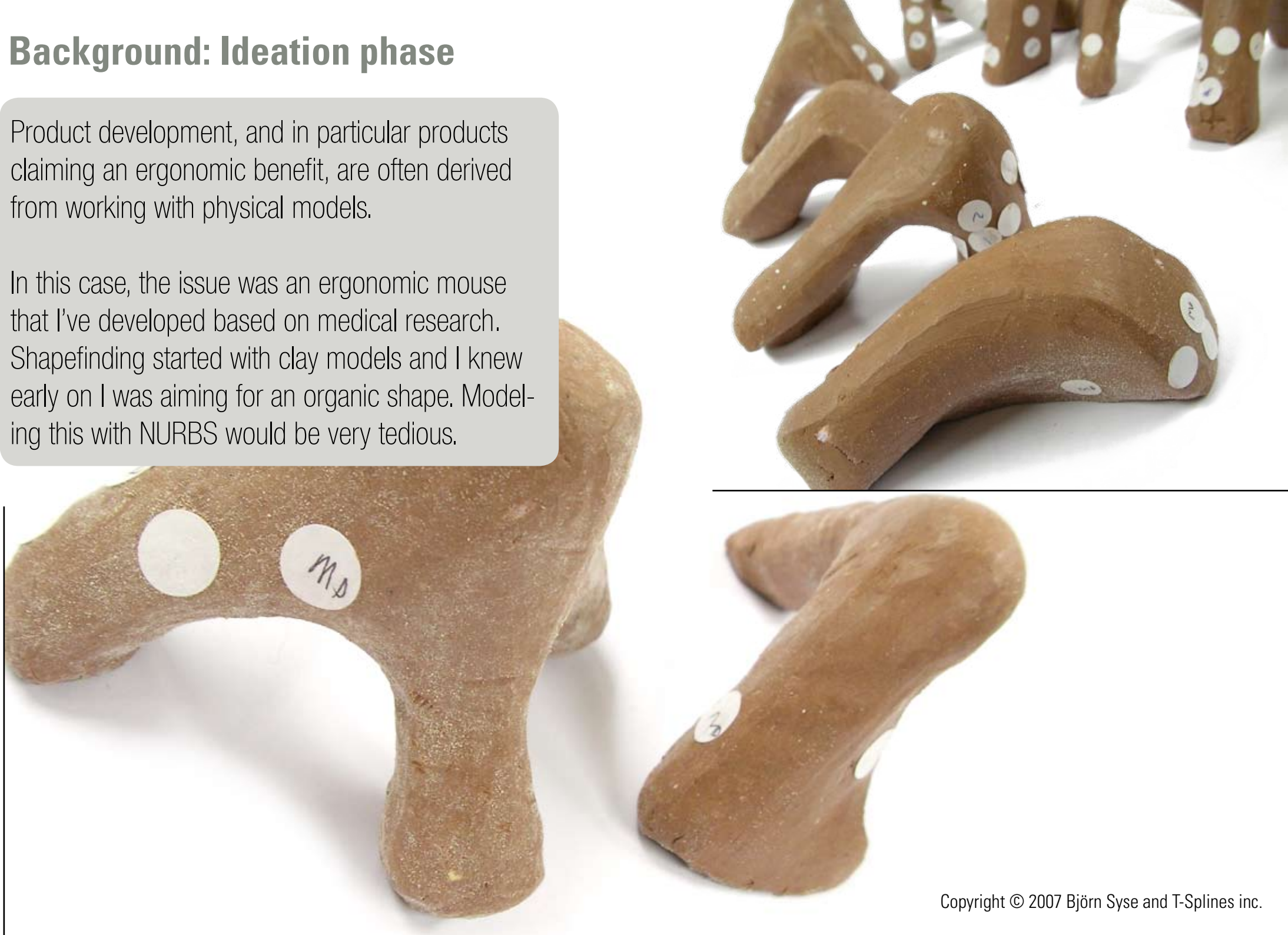
Case study

Organic Modeling for Industrial Design with T-Splines and Rhino®4, using the `tsSkin` command

Background: Ideation phase

Product development, and in particular products claiming an ergonomic benefit, are often derived from working with physical models.

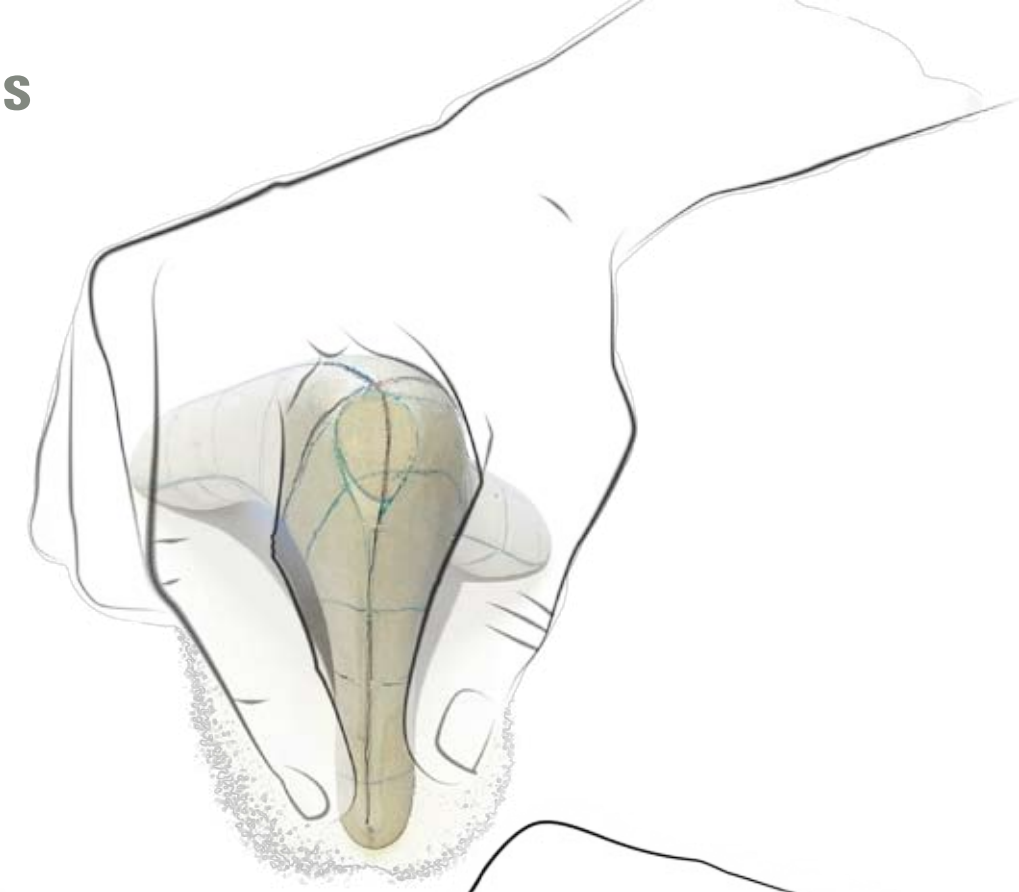
In this case, the issue was an ergonomic mouse that I've developed based on medical research. Shapefinding started with clay models and I knew early on I was aiming for an organic shape. Modeling this with NURBS would be very tedious.

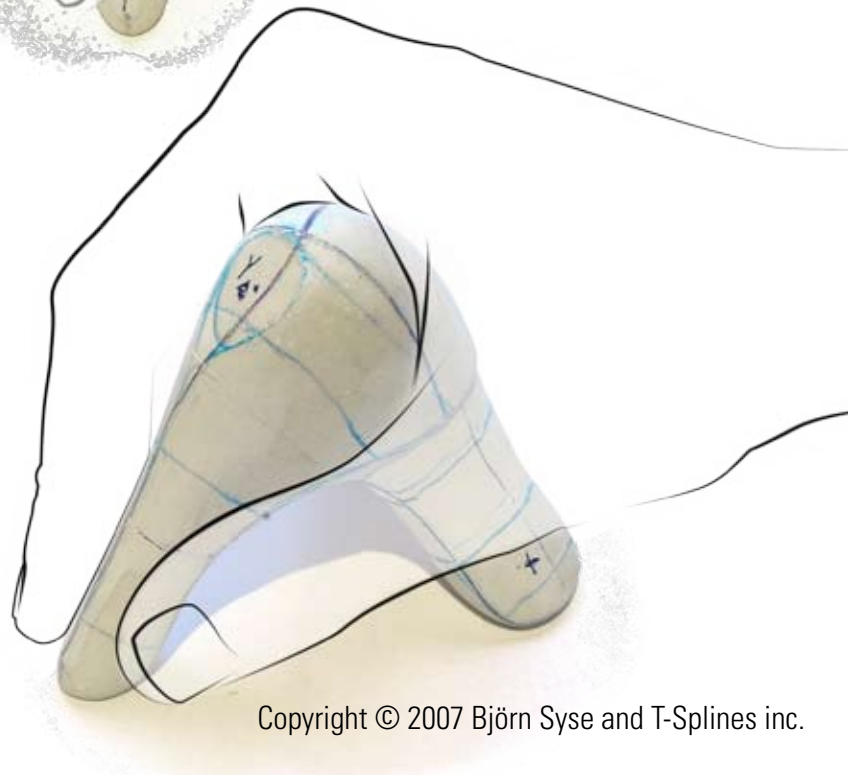


Background: Preparation for input curves

Moving over to a more firm material - foamed polyurethane - the shape of the mouse started to settle.

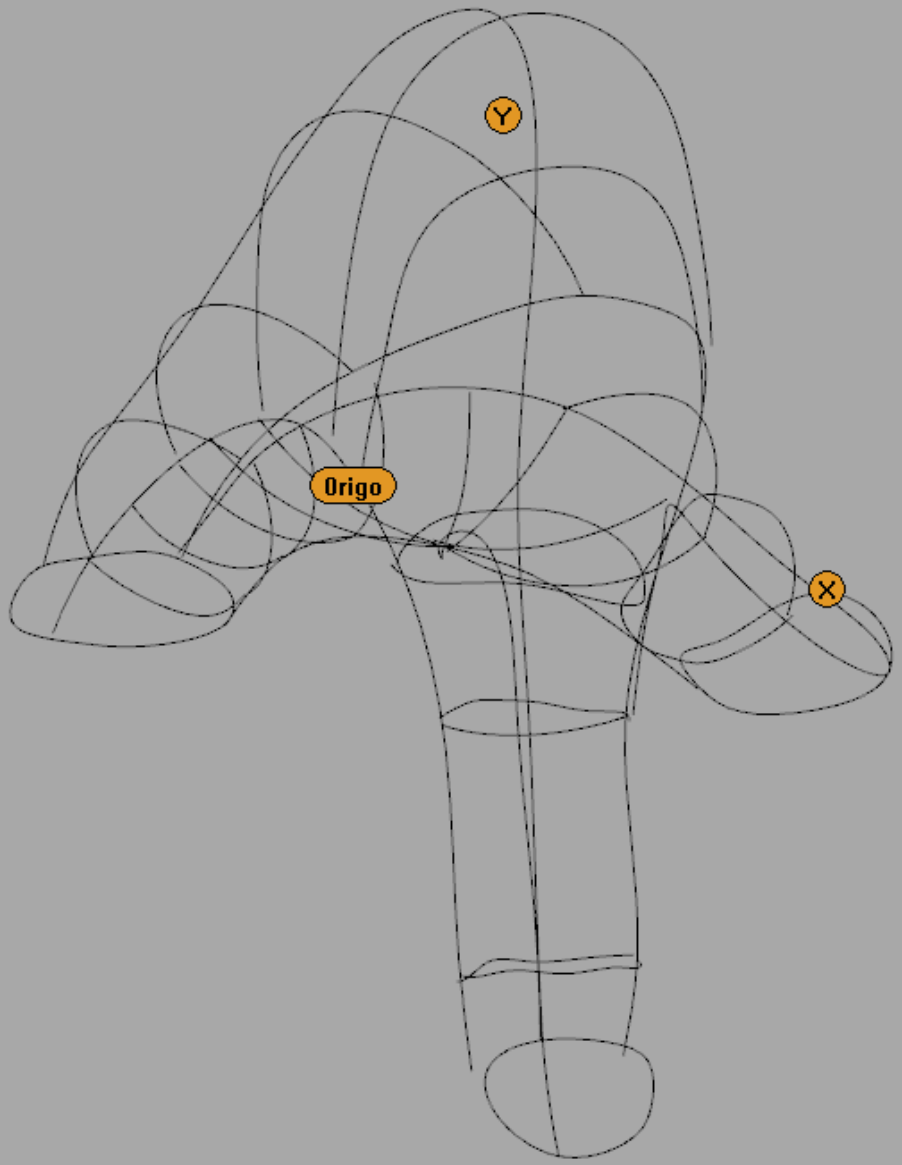
To prepare for the 3D modeling, I traced lines on the model to mark enough curves to define the shape. These curves would later be used for building the surfaces.

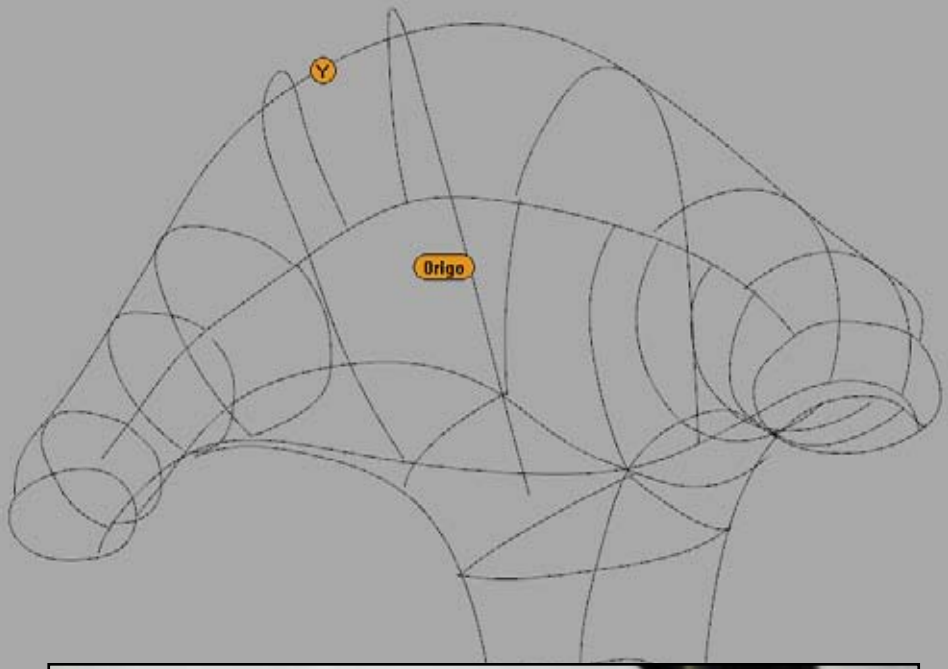




Preparation: Using a digitizer to capture curves

Using a digitizer arm, the curves traced on the physical model are easily transferred into NURBS curves in Rhino© 4.



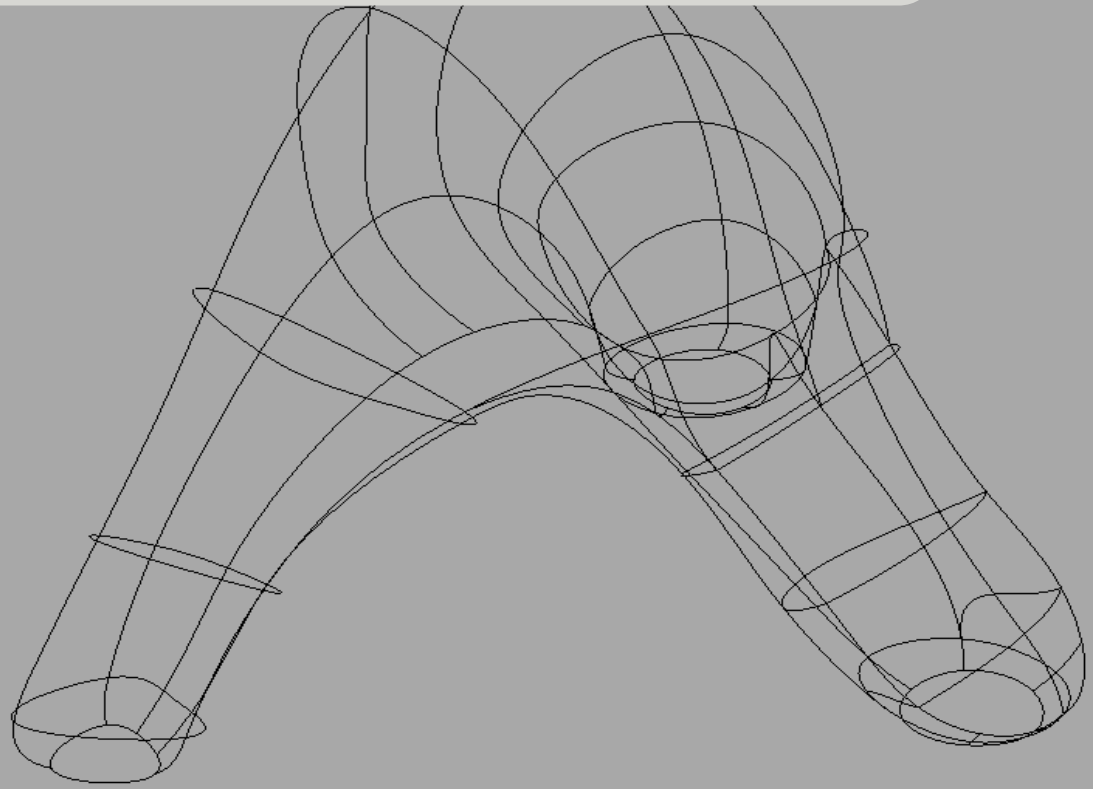


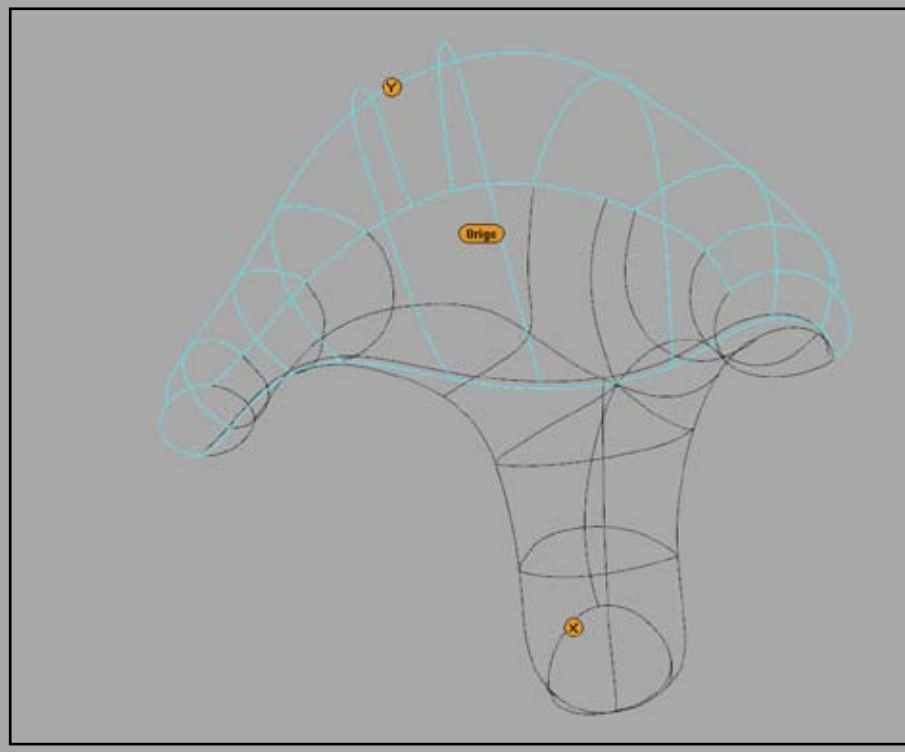
Preparation: Refining the curve layout

Tracing with a digitizer will not produce perfect results, and most often the output curves will need to be tended to.

The raw curves were manipulated, rebuilt and somewhat reorganized in order to match up and provide better input for the T-Splines **`tsSkin`** command.

I also added additional curves using the **`InterpCrv`** command.





T-Splines STEP 1 Select input curves

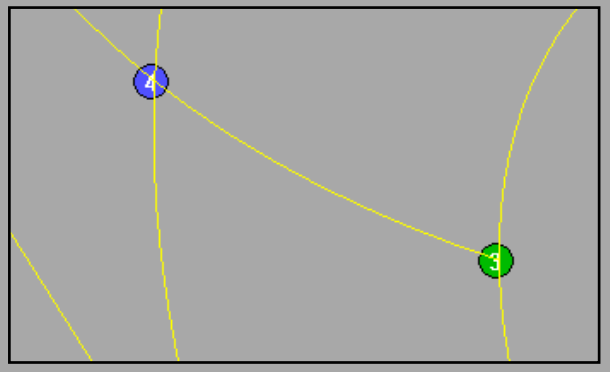
Select all the curves defining the shape and run the **`tsSkin`** command.

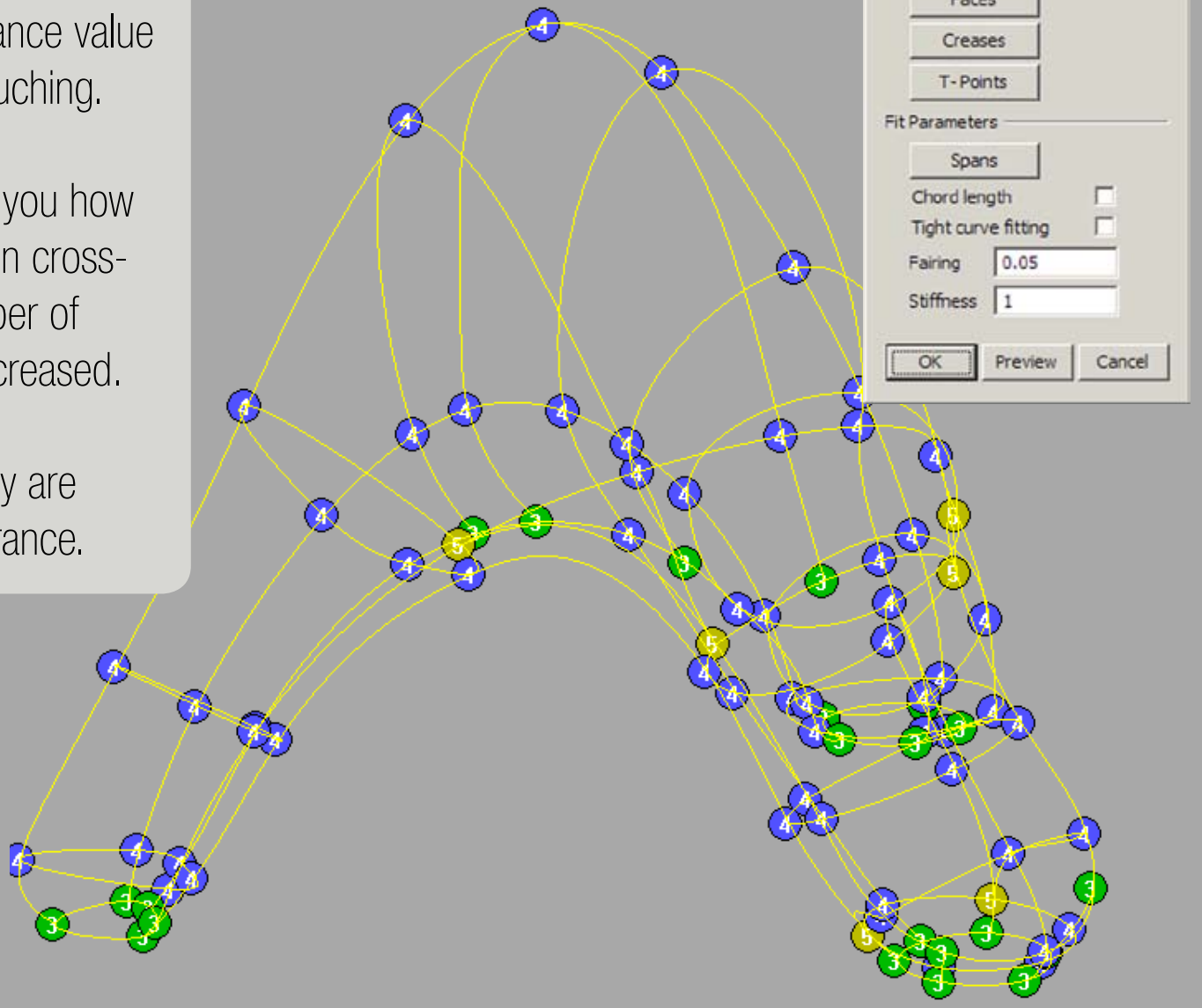
T-Splines STEP 2 Curve intersection

The **`tsSkin`** command divides the curve network according to the tolerance set. A larger tolerance value will regard curves that are farther apart as touching.

Keep your eye on the numbers. They will tell you how many curve divisions are intersecting a certain crossing. If the value is lower than the actual number of curve ends meeting, the tolerance can be increased.

For best results, see to it that the curves really are touching before skinning, and use a low tolerance.

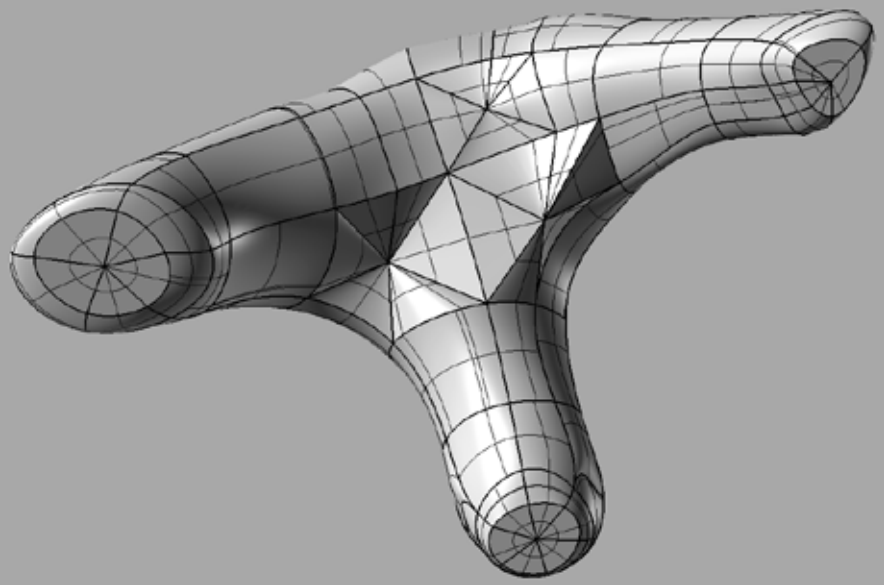


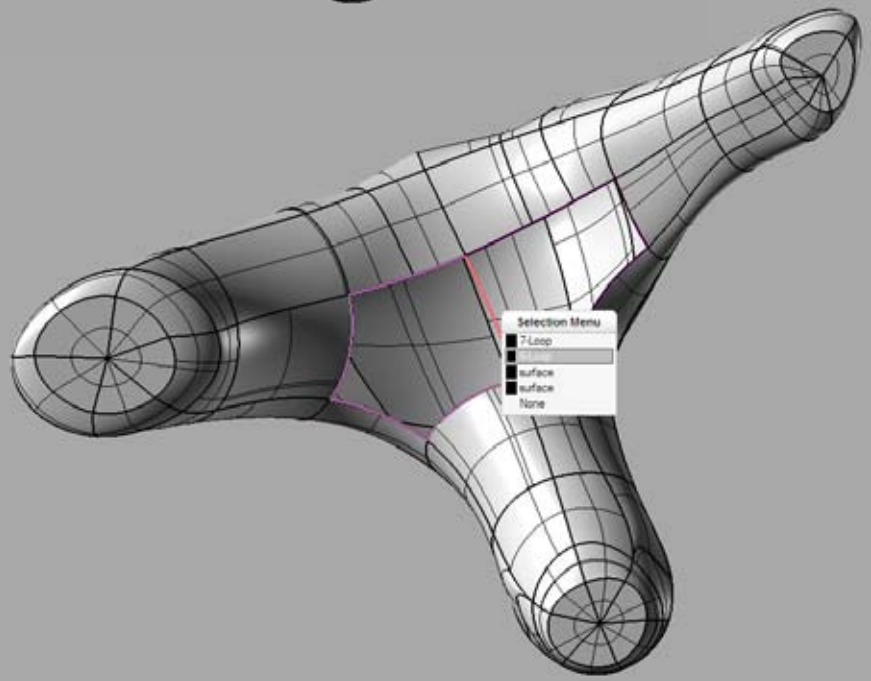


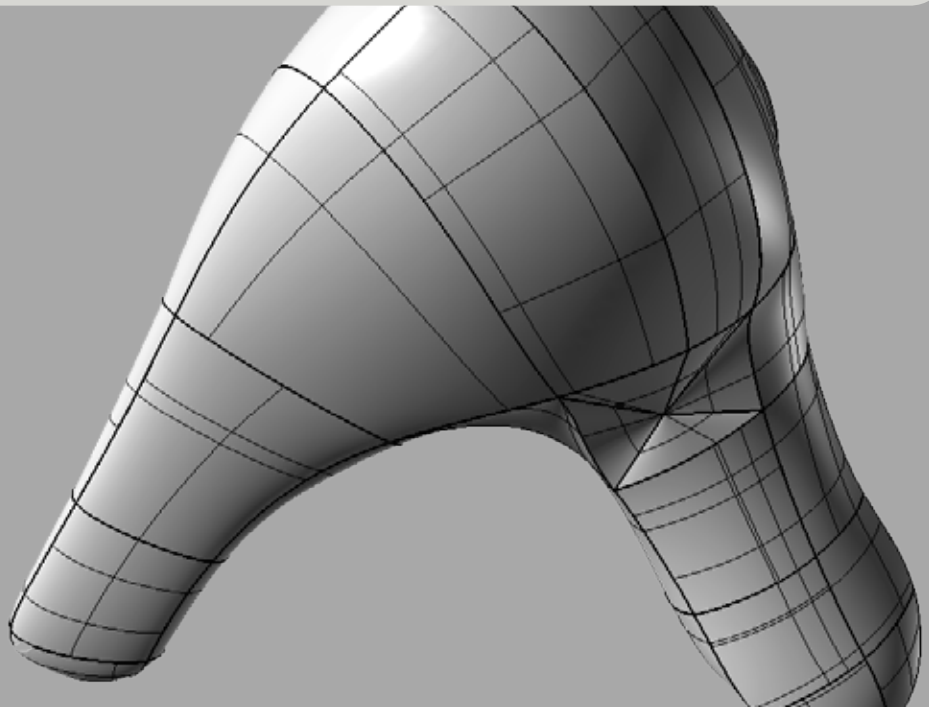
T-Splines STEP 3 Topology - the distribution of the surface

When previewing the topology, simple surfaces are generated to visualize and provide an interface for changing the distribution of the surface. This is basically just a way of telling the plugin where you would like surfaces, and where you would like openings/holes.

In my case, I wanted a closed surface, so by clicking the surrounding edges I turned on all faces.



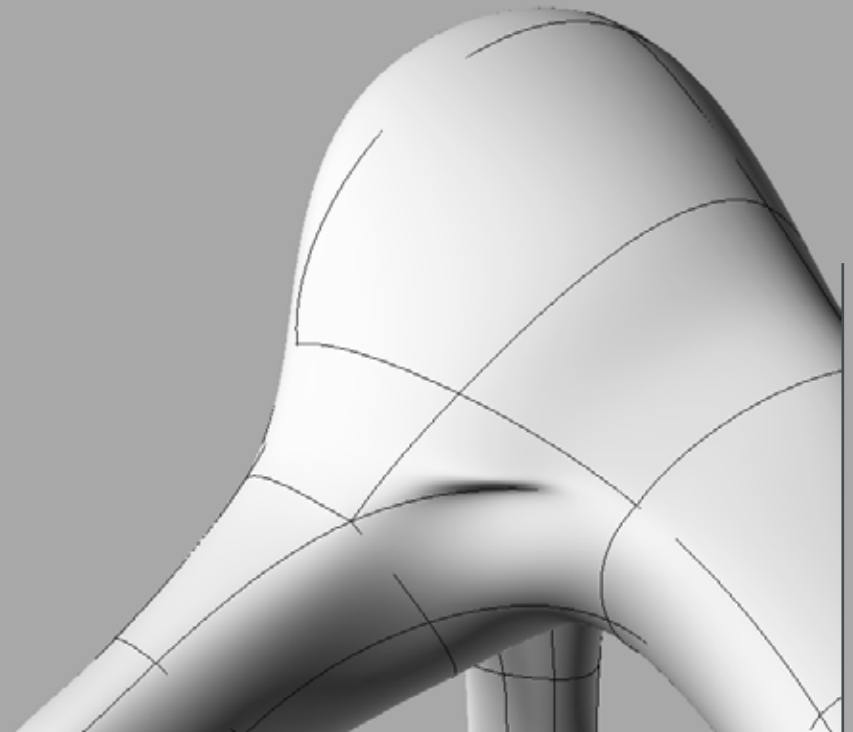


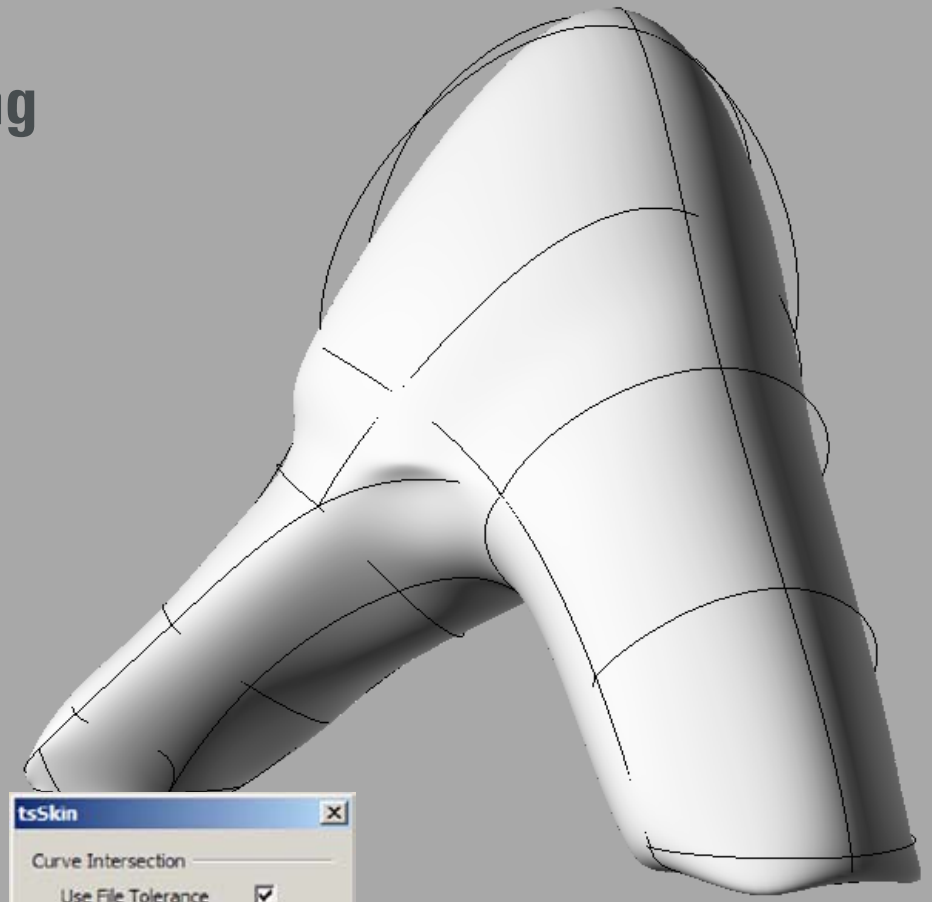


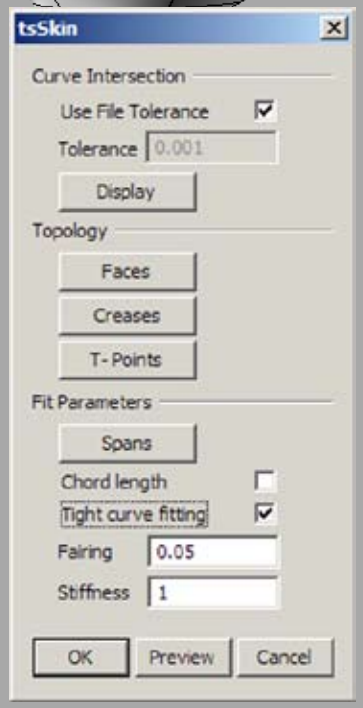
T-Splines STEP 4 Adjusting the fitting

With fitting turned on, there are a few ways of adjusting the behaviour of the surface. Without knowing the exact mechanism behind how these work, one can easily tweak by trial and error using the preview button.

Here I'm adjusting a parameter making the surface flow tighter along the original curves.



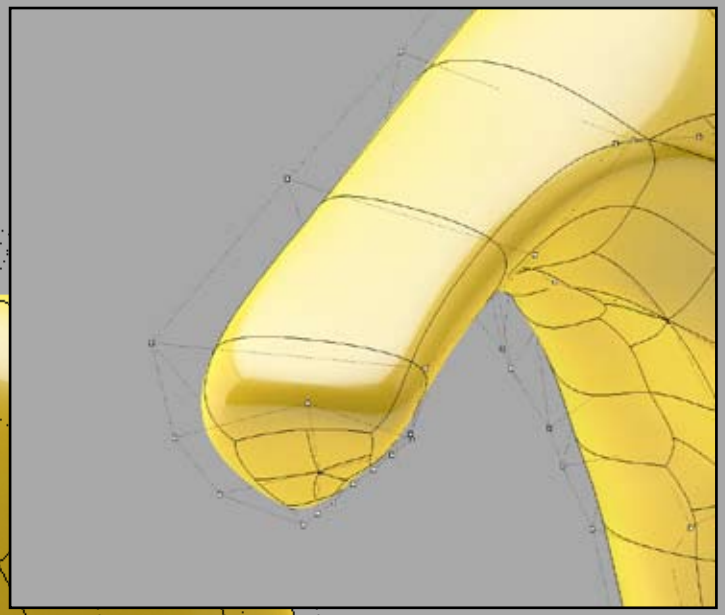


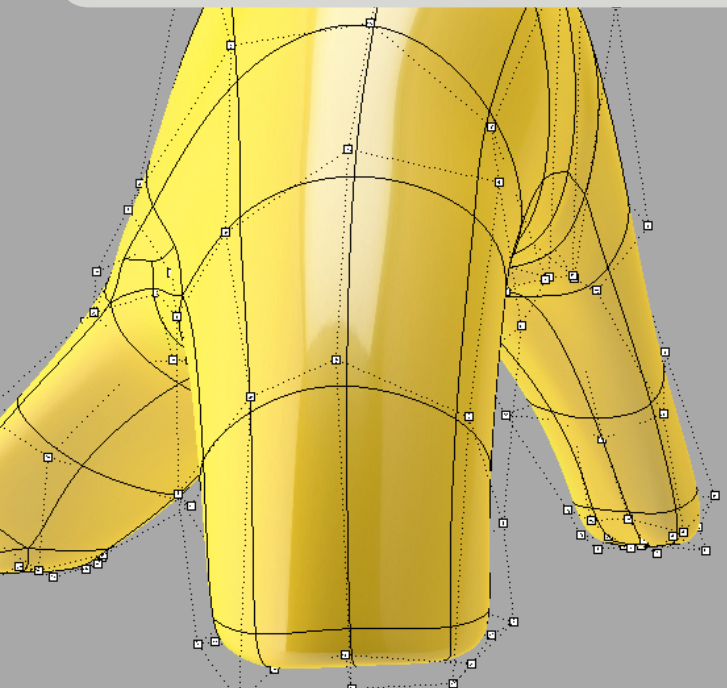


Manual tweaking

Compared to working with NURBS patches, the T-Spline remains a single editable surface, and even better, will have up to 70% less control points situated only where needed. This makes it a charm when it comes to tweaking the surface to adjust the shape.

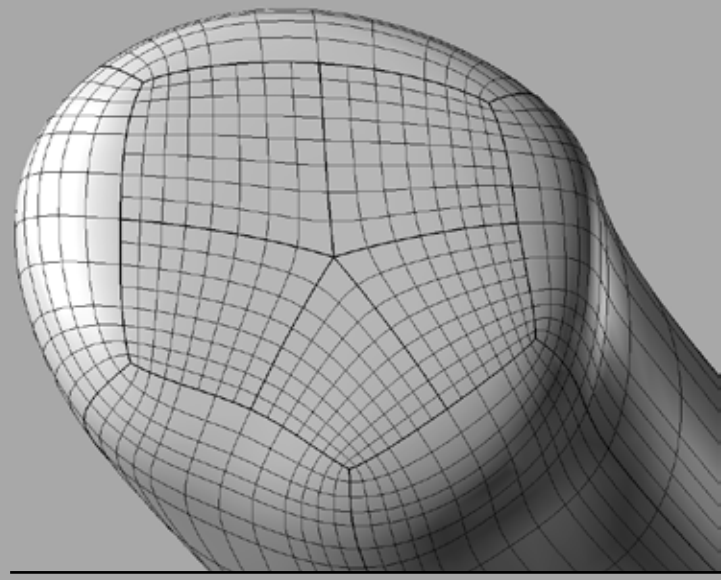
If more control is needed, extra points can be added using **`tsInsertPoint`**. In order to simplify the shape, points can be removed with **`tsDelete`**.

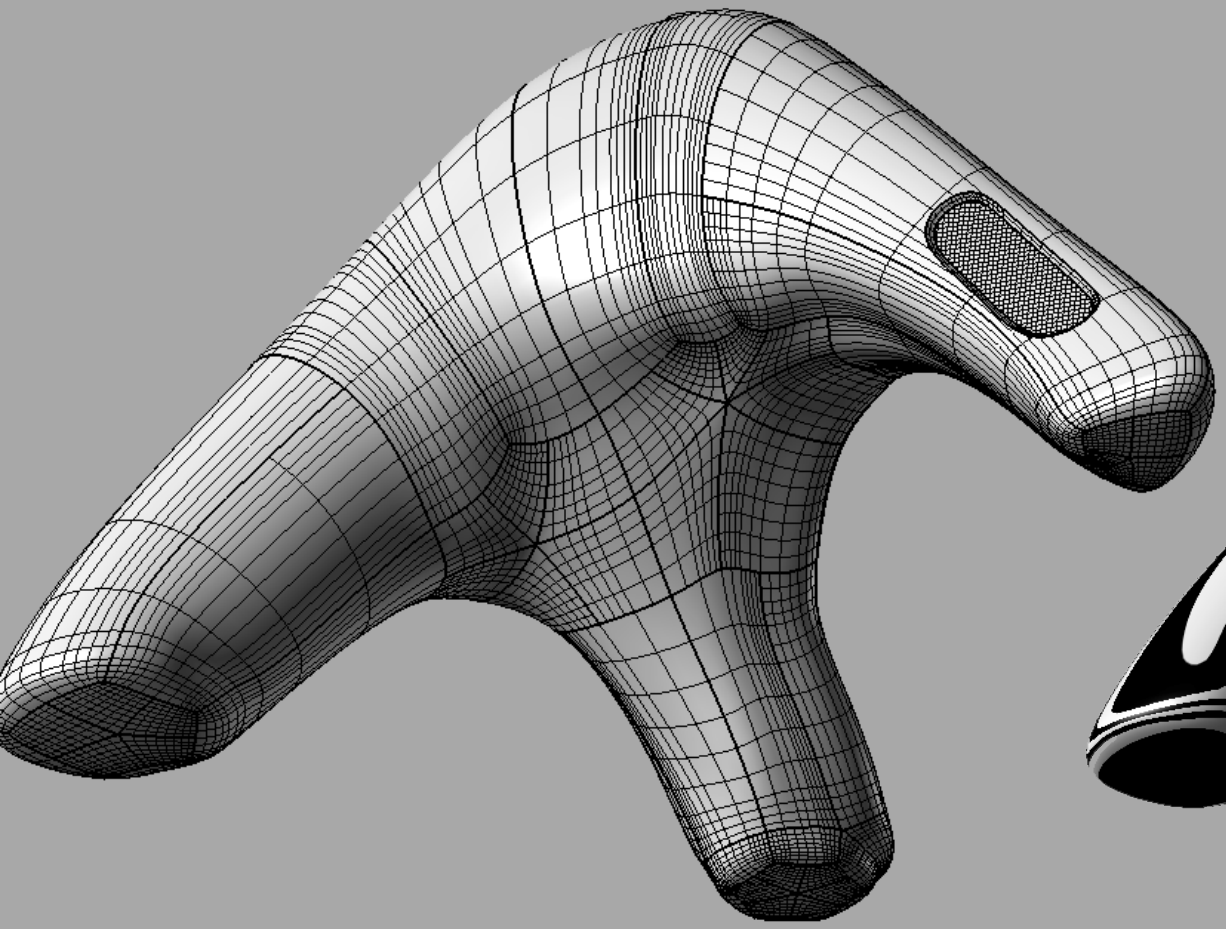


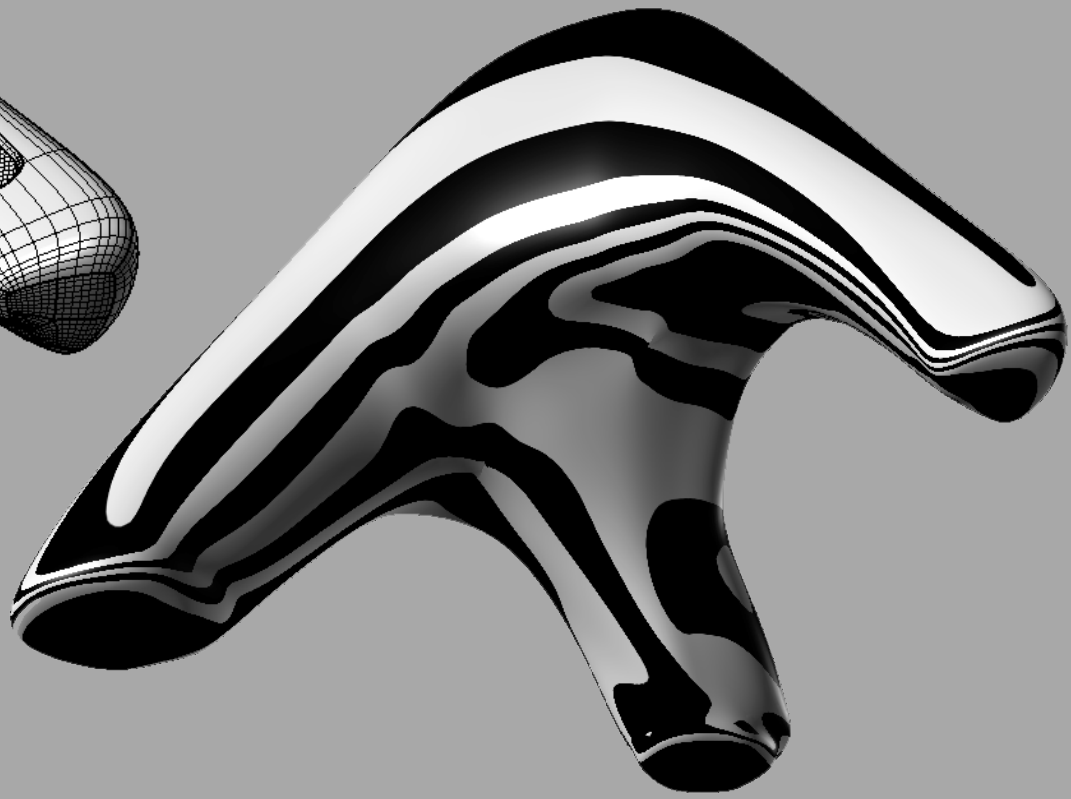


T-Splines are converted into NURBS patchwork

After converting to NURBS, the curvature continuity between patches is preserved.

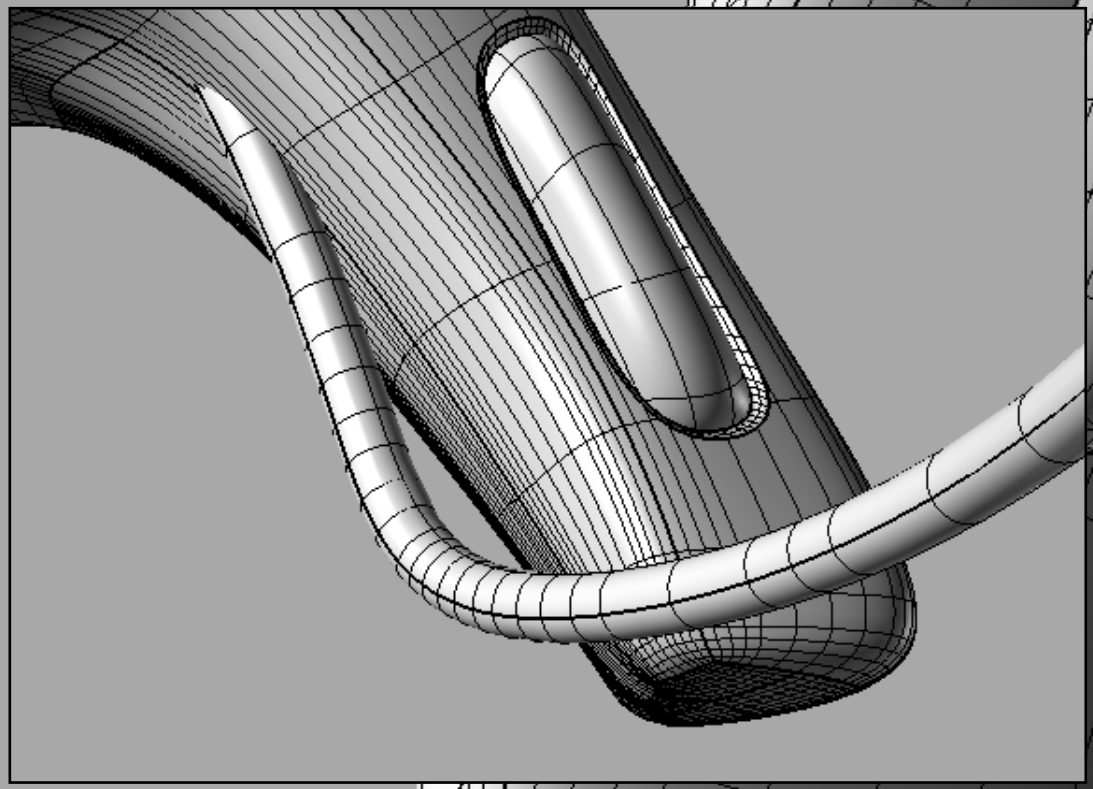






Post work: adding details

With the overall shape readily modeled in T-Splines, details are added using any given NURBS technique.



Render and physical model side by side

About the author

Björn Syse is on his final year of Industrial Design studies in Visby, Sweden. He concurrently works as a consultant specializing in 3D-modeling and visualization.

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