# T·Splines

# Organic Modeling with T-Splines and Rhino® 4



*A case study in free-form jewelry design*

**Ricardo Amaral,**
Modellistica

# Introduction

I have been using Rhino since 1998. After first using it for 3D rendering work, since 2003 it's been a key part of my rapid prototyping business, which covers mostly jewelry. Rhino has been the best companion for years.

# The problem

However, one area I have always struggled with in Rhino is with free-form jewelry designs. In the past, I have rented a seat of Maya to design these projects with subdivision surfaces, make all my tweaks to the design while still in Maya, then export a NURBS, bring it to Rhino, and work with the model as a piece of immovable geometry.

# The project

Recently, I needed to create a branch-shaped ring with hearts in place of leaves as a gift to my wife. I had modeled a similar ring in the past using my previously described workflow, but rather than renting a seat of Maya to do the redesign, I decided to try to complete the whole project inside Rhino 4 using T-Splines.

# The solution: T-Splines

I had done production work in the past using T-Splines to make free-form surfaces, and liked how easy it was to edit them, but this was my first time using them in manufacturing. I was pleased with the results. I was able to build a smooth and continuous surface that I could easily edit to cope with aesthetic, design and fabrication issues. The whole modeling process took me six hours.

# The process

The following tutorial walks step by step through my modeling process. In short, most of the modeling work was done using the T-Splines "Skin" command (to quickly generate a surface) and the T-Splines "Insert Point" command (to add local control). Towards the end of the process, I was able to seamlessly use some new features available in Rhino 4 to finish the production. The tight integration of T-Splines with Rhino made this workflow efficient.

T•Splines

# *1* Sketching

Basic form finding was done by hand sketching and 2D illustration programs, with this final concept:
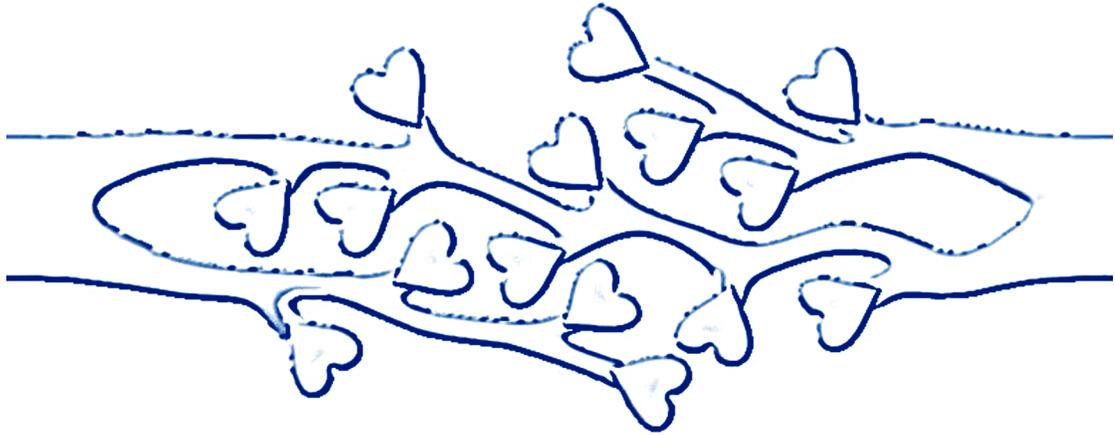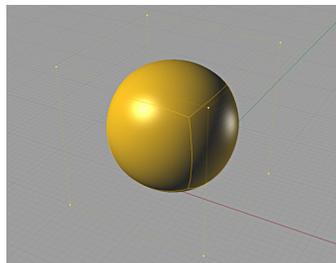


The shape was defined in developed format, to be later bent into the ring model.
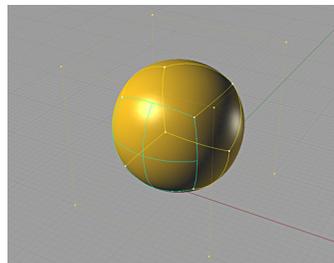
# *2* Model planning in Rhino
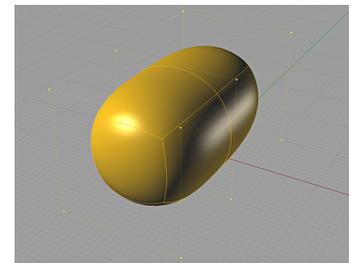
I considered two approaches:

1. Modeling in a subdivision surface-like workflow, using T-Splines "Face extrusion".
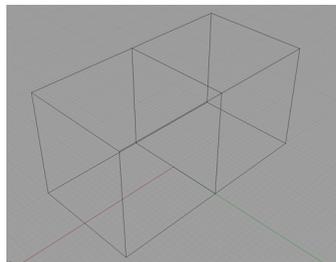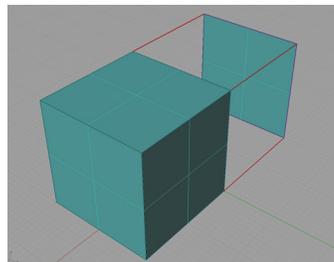


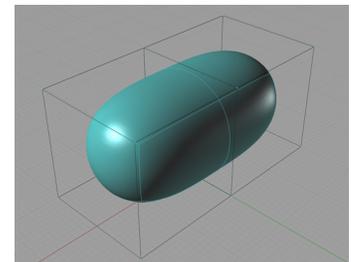*T-Splines sphere*  *Face selected*  *After face extrusion*

2. Building the shape from a cage, using the T-Splines "Skin" command with no fitting.



*Line cage*  *Inside the command*  *Final shape*

Both strategies would have delivered the desired shape, but since I had already laid out the topology, I went with T-Splines "Skin." Notice that by not using the fitting option in this command, I got one control point per line intersection, providing for easy topology planning and easy-to-tweak geometry.
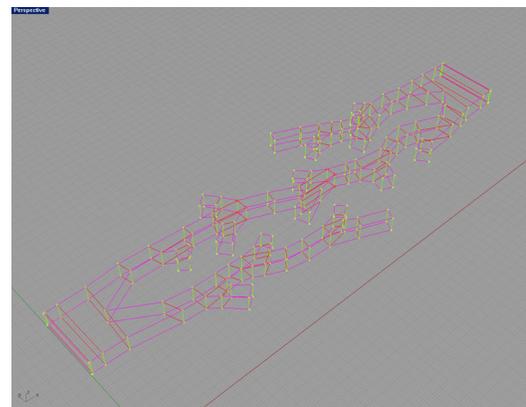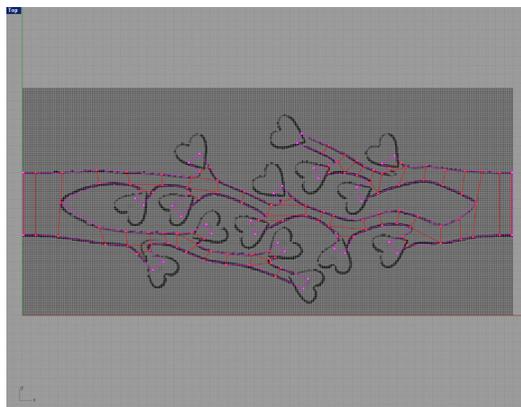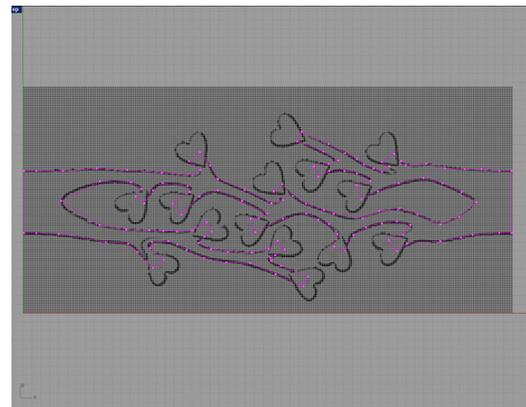
T•Splines

## 3 Building the cage

The first step was simply designing a polyline around the desired shape.

T-Splines "Skin" can work with pretty much any topology, but squares are desirable, so I tried to keep the number of corners as even as possible.

The final polyline mesh had a pair of five-sided areas, and everything else was squares. Next, the 2D plan was converted into a 3D cage by copying the plan and adding pillars.







## 4 T-Splines "skinning"

At this point, I entered the T-Splines "Skin" command, which is a three-step process. The first step is dicing, where the topology will be split at intersections.

Next the command tries to figure out the topology. Some tweaks are usually needed. The tweaking process is a fun-to-play puzzle, in fact.

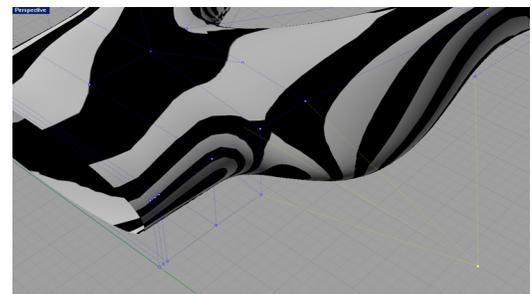Setting priority to the ground curves fixes most of it at once.

T•Splines
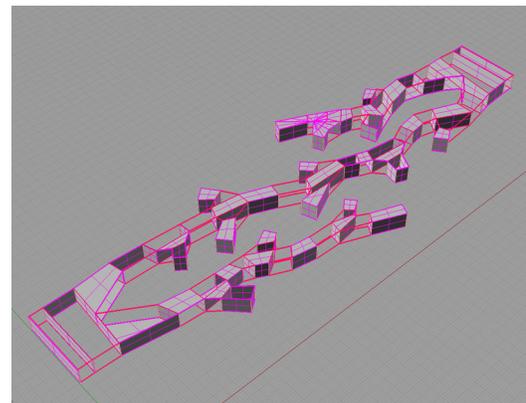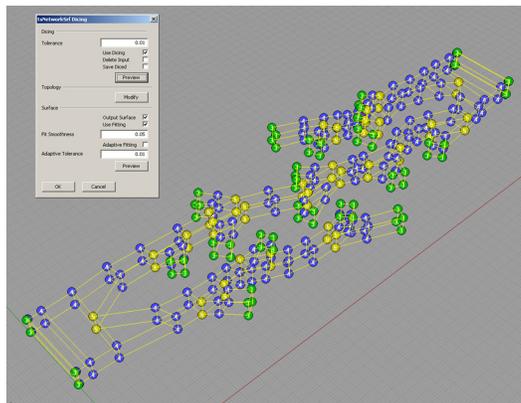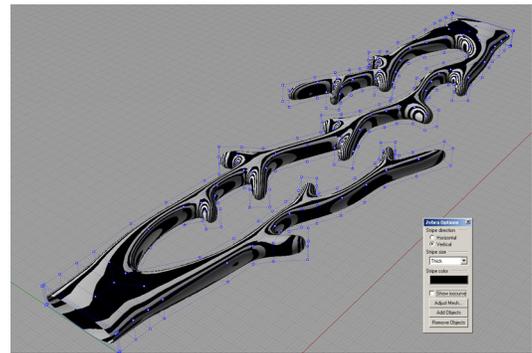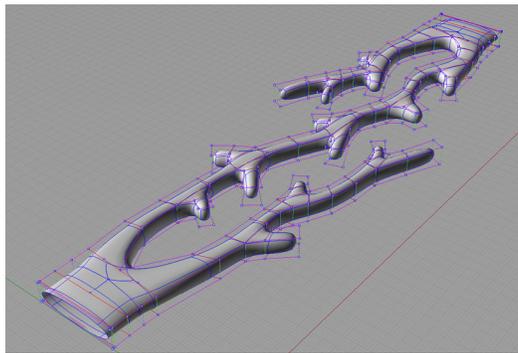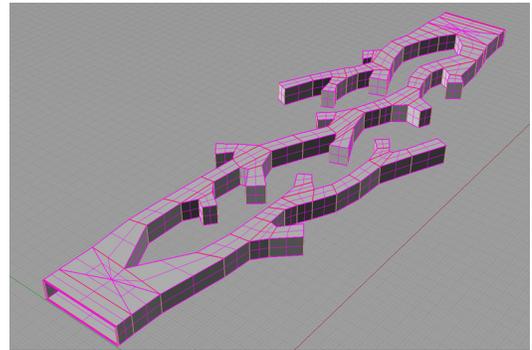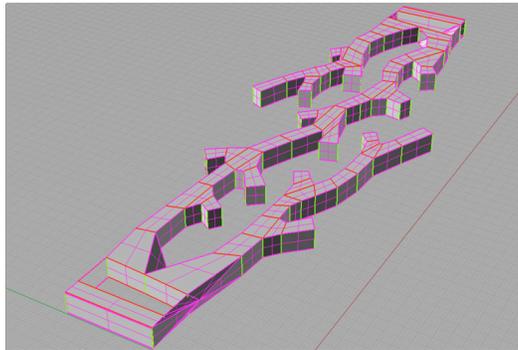
Preview surfaces are added and deleted by clicking over them and in a few minutes everything is set up. The ends where left open so they match when the ring is bent.
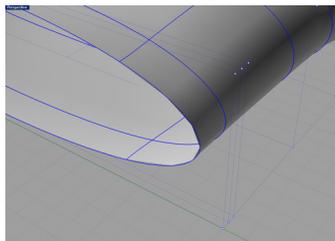
Fitting turned off, one click and presto.

The final result is a single, smooth and editable polysurface, with 266 control points.
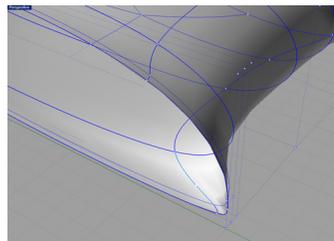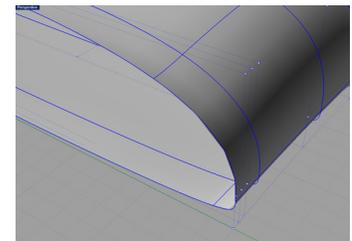


## 5 Adding detail

The geometry can still be refined by either inserting or removing control points. In this case I wanted a thicker base, so I used T-Splines "Insert Point" to insert some points to the main branch.



*The original surface*



*Begin point insertion*



*The final shape*

I chose to use simple T-Splines point insertion, which will disregard the surface geometry and append directly to the control cage. It is possible to add individual control points instead of an entire row.
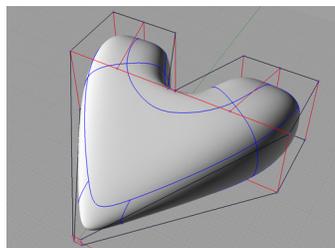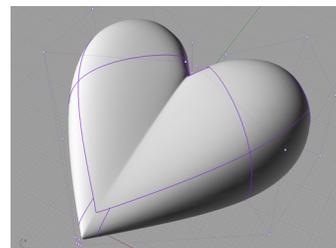
T•Splines

# 6 The heart shape

The heart shape was designed using the same strategy, a cage, T-Splines "Skin", and point editing.
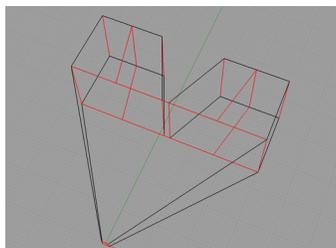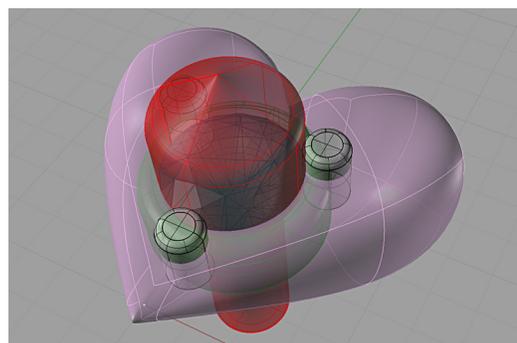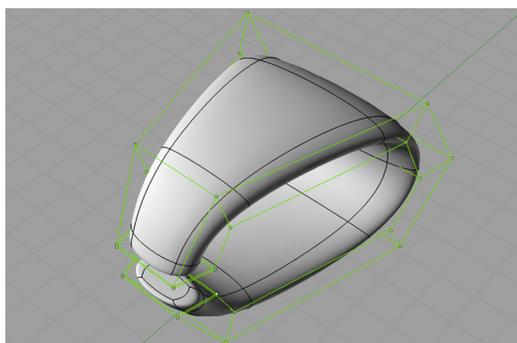


*The line cage*



*T-Splines "Skin"*



*The final shape*





The collection included a pair of earrings and a necklace pendant. The pendant link was also built with T-Splines "Skin."

The heart shape then received stone setting geometry, using TechGems 4.2.

# 7 Parts layout

The hearts were placed as blocks (using the Rhino "Block" command) on the branch network as shown at right.

Now T-Splines came in really handy. This layout had two problems: in some areas the branches were too thick and covered the hearts' tips. On other areas, the branches barely touched the hearts, which is a bad idea for rapid prototyping and casting. Some very quick point tweaking fixed this.

Now everything was in place to turn the model into a ring.
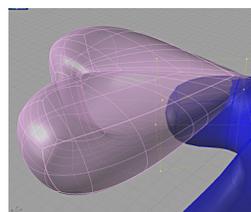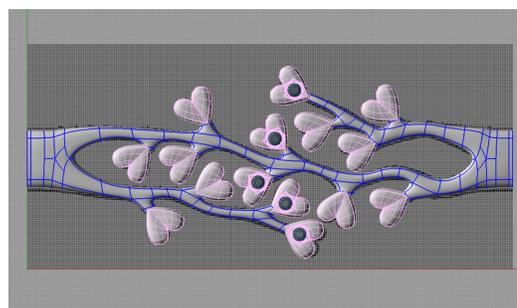




*Bad branch/heart interface*
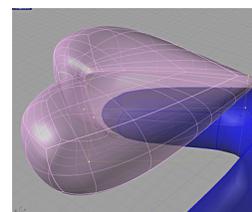


*After one minute of tweaking*

T•Splines

## 8  Making it round

The branch shape was rounded using the Rhino "Flow Along Surface" command. The hearts (defined as blocks with the setting geometry in place) were transferred from the plan layout to the ring with the Rhino "Orient On Surface" command. Booleans were then performed to get the final model.
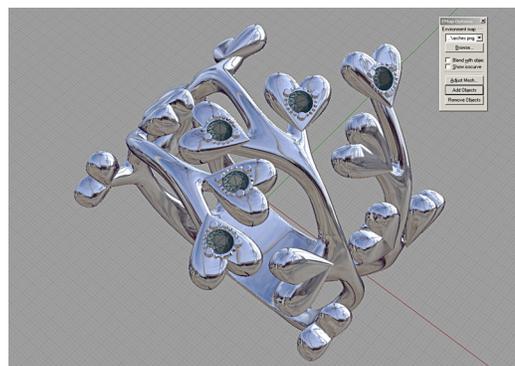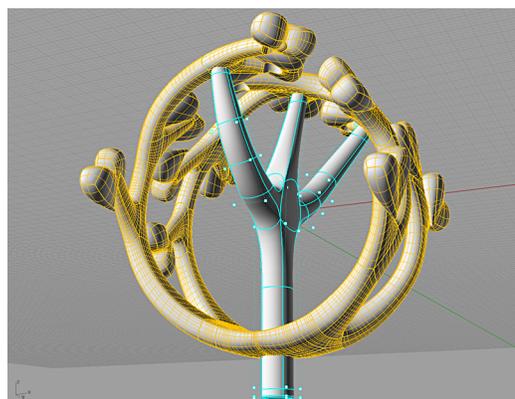


## 9  Ready for rapid prototyping and casting

The final step was to build sprues for investment casting.

The sprue was designed out of a cube using the T-Spline "Extrude" technique mentioned previously.



## 10  Making it from bits to atoms

Alongside with the ring a necklace pendant and a pair of earrings where designed using the same heart shape. The parts where converted into STL and printed in a Solid-Scape's T612-BT2.

The RP waxes were then cast directly in gold, with stones pre-set in the wax.
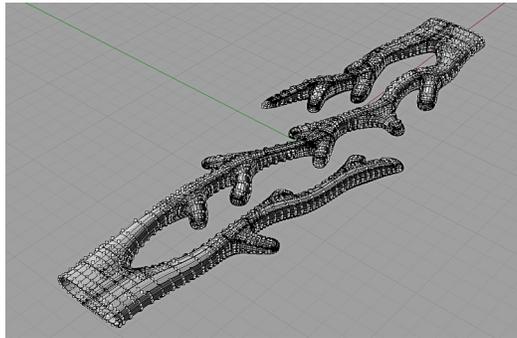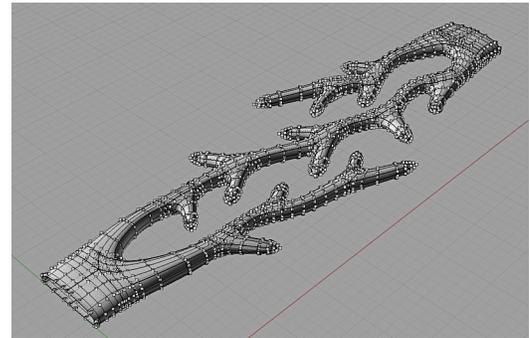
T•Splines

# Concluding thoughts

T-Splines did an excellent job at keeping the surface as simple as possible while I was modeling my organic ring design. By using T-Splines' powerful set of tools, the project yielded the fewest possible control points, keeping the geometry easy to read and edit. T-Splines fills the need for free form modeling tools in Rhino.

I had previously made this ring in Maya as a SubD and converted it to NURBS Rhino. I redesigned the ring in T-Splines since I needed to recast it. Here is a comparison between the first ring and the second ring:



SubD model



T-Splines model

The Maya SubD model was converted into 348 NURBS surfaces, while the T-Splines model was converted into 148.

- **Fewer surfaces:** The Maya SubD model was converted into 348 NURBS surfaces, while the T-Splines model was converted into 148. Most of the work, though was done in while the model was a single T-Spline surface (with drastically smaller number of control points than the SubD).
- **Rhino compatible:** The SubD model couldn't be edited in Rhino, it would be a nightmare.
- **Tight integration:** I had to rent a Maya seat to do this the first time; with T-Splines I could work in my familiar Rhino environment.
- **Time saved:** The T-Splines ring (six hours) took less than half the time to model than the Maya SubD ring (two/three days).

*Ricardo Amaral studied naval architecture and has done NURBS modeling since 1990. He currently runs Modellistica, a rapid prototyping service bureau he founded in 2003.*

*Contact information:*
*ricardo@modellistica.com.br*
*http://www.modellistica.com.br*

*For more information about T-Splines for Rhino, go to **http://www.tsplines.com/rhino/**.*

T·Splines