

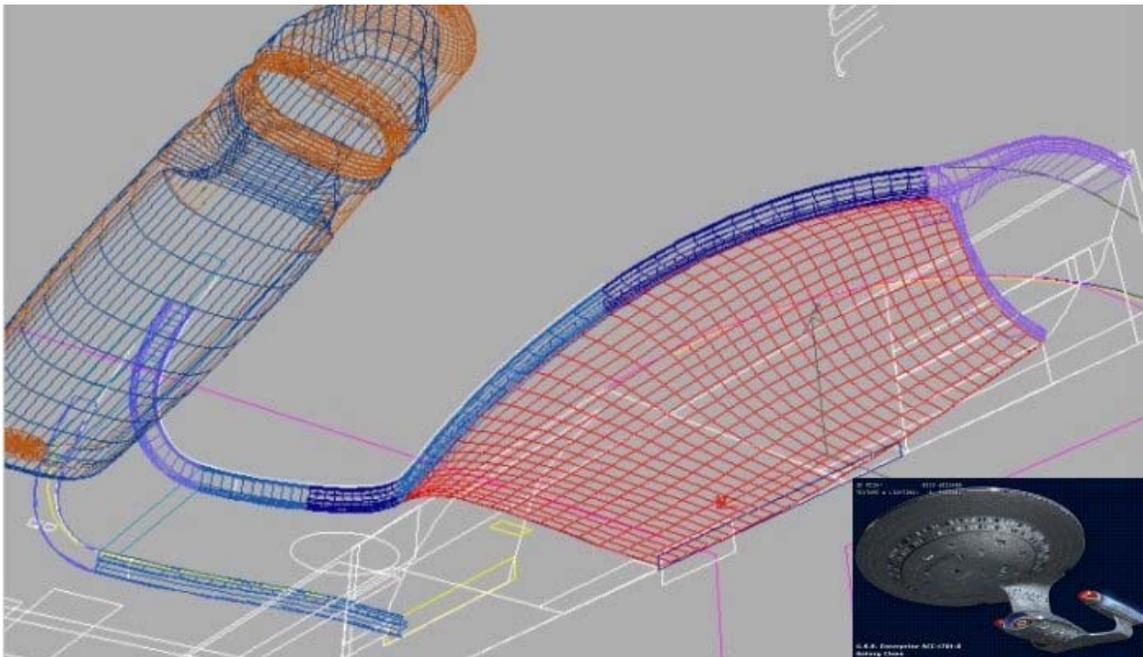
# Loft/Splincage Tutorial

by

Nico Weigand for 3D Max

In this tutorial I wanna tell you something about the technic I used for my best st modells (Galaxy, Nebula, Akira).

But I must warn you - this tutorial isn't for the beginner. It's for the advanced user of max who is willing to push his knowledge some steps higher and who knows where the buttons are.



The first thing you have to understand now, is the way geometry is built in max. In real world every object is made out of a material which fills out the space of the object (stone, wood, metall...), but here in cg you have to think in other directions. Objects here consist out of points and faces, which are forming a hull - the objects are hollow. The best way to understand this would be to imagine the objects as made out of thin paper - cutted, folded, glued or even papier mache for round parts ;)

\*Explanation: rmb = right mouse button

Allow me an advice: If you're a newbie to max, or don't know what a spline handle is, or where to find the stack or the modifier menu and you want to build a ship like above, first get extreme in touch with these things - they should have to be in your brain and not only on

your hdd in a tutorial... keep in mind that the learning time for this prog normaly takes two or more years.

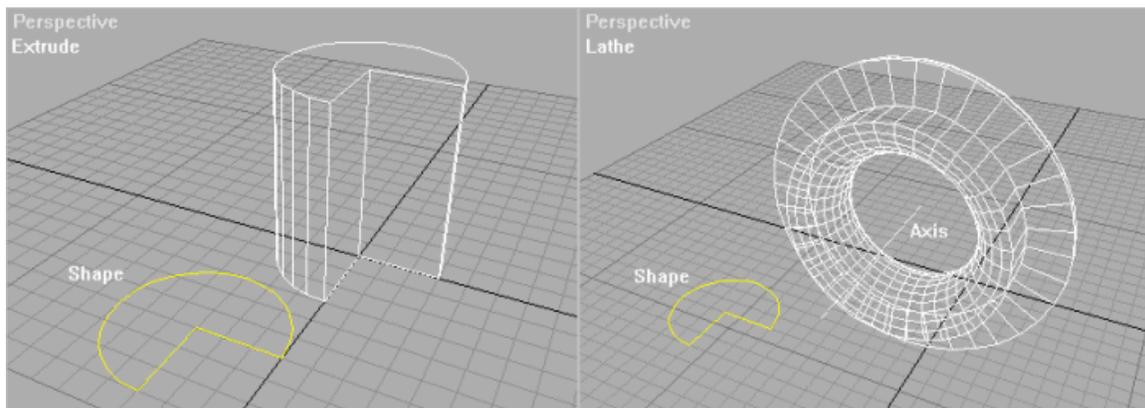
To the more experienced: that's not all, there are some more tricks, like cutting the hull without boolean and getting smooth edges, but if I tell them all I won't be a favorite, so be patient, my next tut comes surely ;)

Oh, and a thanks goes to S-Stephen for reviewing this tut. :)

## Loft and Similar Techniques

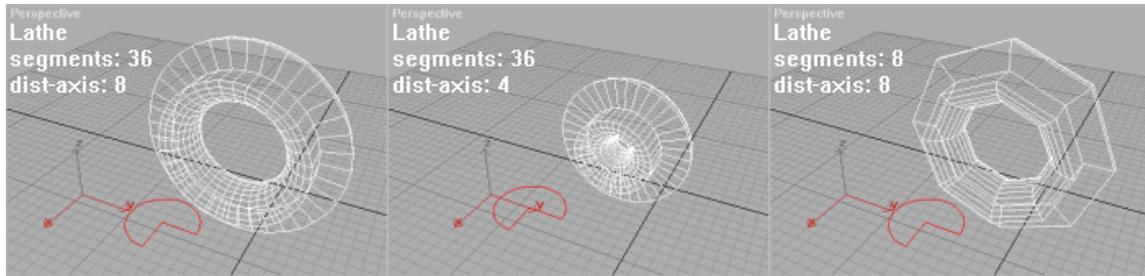
All three technics using splines or shapes as origin for the process. In some cases extrude and lathe are similar to loft, that means you can achieve the same results with a easier way of creation (lathe or extrude instead of loft).

As general rule we could say that lathe is good for circular things with a constant shape and extrude is good for straight parts with a constant shape.

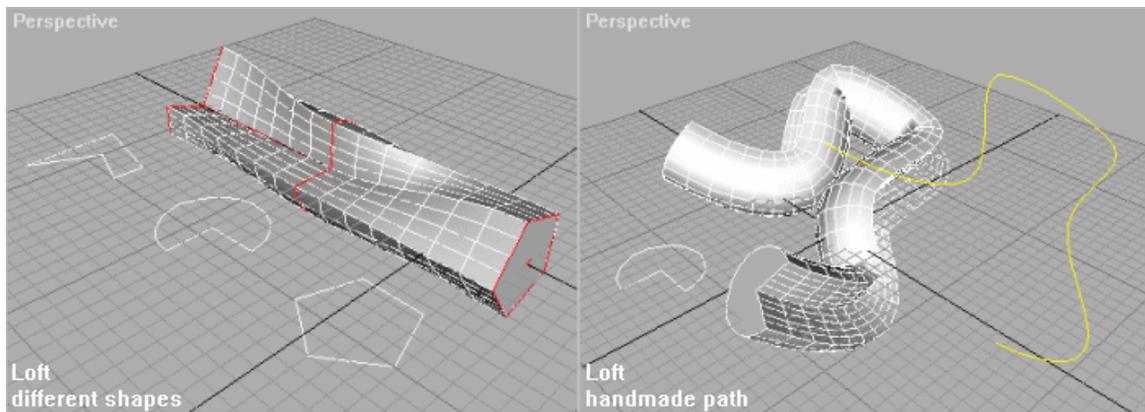


Have in mind that the position of the pivot-point relative to the shape is important for lathe, cause it get's the rotating axis out of this relation. If problems occur, like 'The shape had been extruded sideways' you have to rotate the spline-subobject into the right angle to the pivot-koodinate-system which is mounted to the shape.

The tiling of the lathe object, called segments, naturally controll one part of the detail (along the path) of the extruded/lathed object. The detail of the shapes will controll the segments of the spline - 'shapes steps' ;)



Now loft is much more than only a cross between these two modifiers. You can use different start-middle-end shapes (lathe/extrude only one), every thinkable loft-path (extrude only linear, lathe only circular) and got more deformation-options on your hand, like: fit, scale, twist aso.

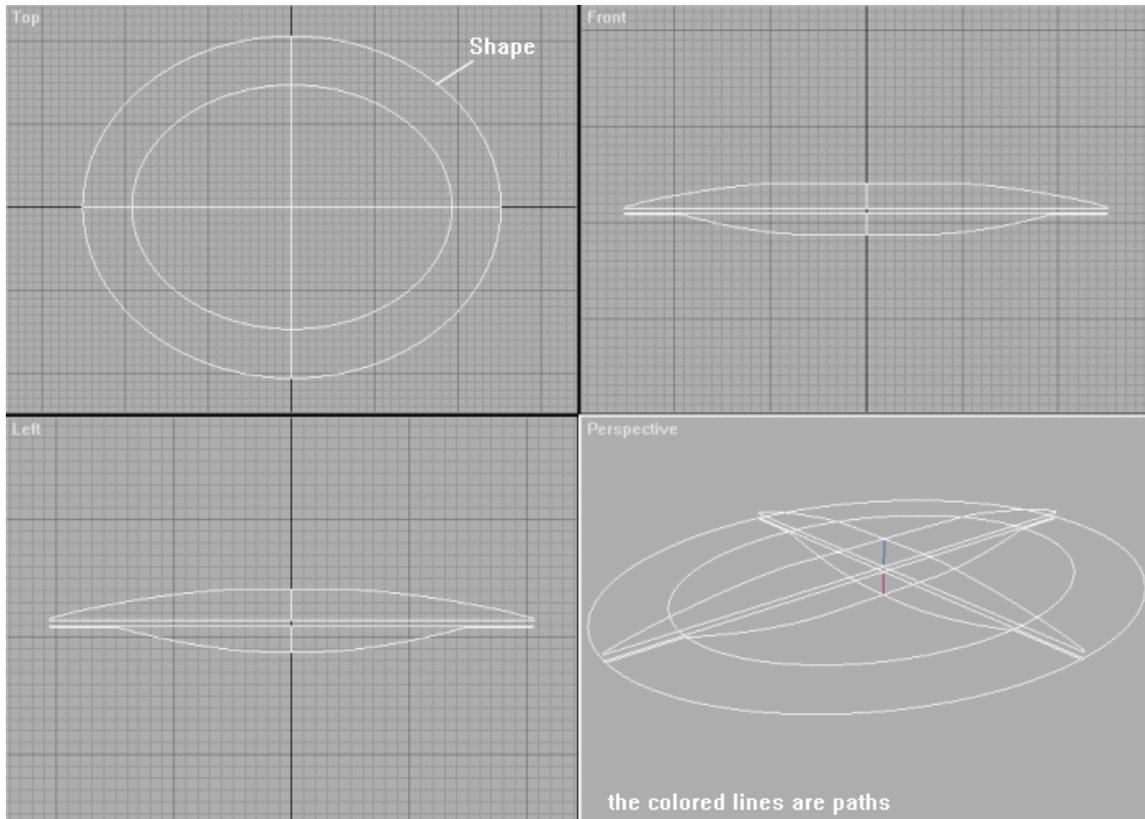


Ok, as a little exercise we'll make the start of a primary galaxy hull.

## GALAXY EXERCISE

At first we need the outline of the saucer. Construct such Outlines everytime with GridSnap ON, otherwise the following steps aren't possible, or at least the results won't be precise.

get the exercise-file >>> [here](#)



Now, we'll do the parts - but before we must divide the front and left outline shapes horizontally into two parts. This is needed, cause we want an optimized mesh. That means, we'll create a mesh with an optimum of used faces/vertices for a smooth result. We won't create a mesh, who has too much avoidable faces, which we need to optimize later - we do this at the creation process and not afterwards, where it is harder.

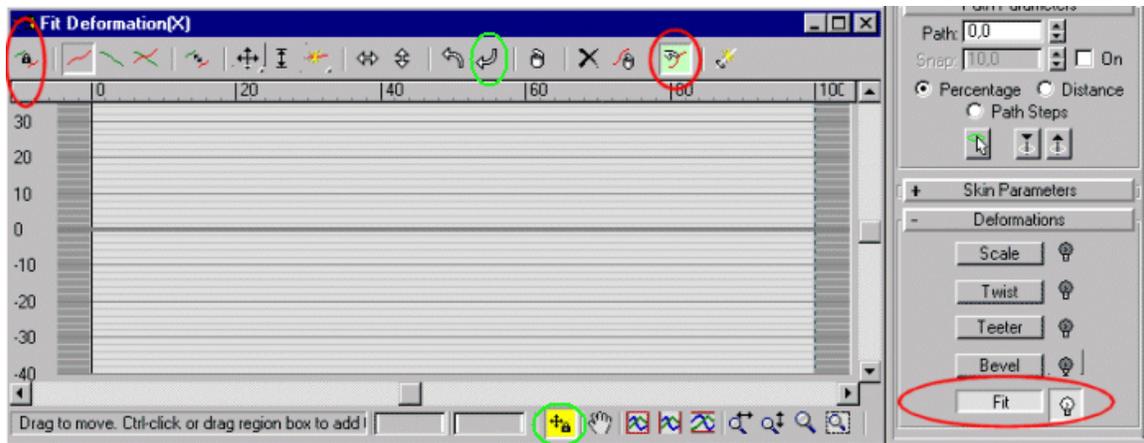
This will be controlled by the path steps of the loft very easily - for loft one 20 path-steps, for the 2nd and 3rd only 3 path-steps and for the last 14 path-steps. Don't mix this up with the shape steps!

Ok, here you can see the divided shapes. If you count right we'll do 4 lofts, two extruded parts and one special part for closing the flat underside of the saucer.

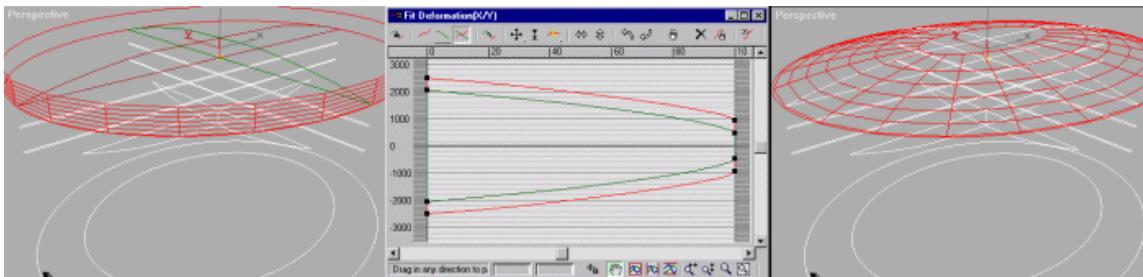
At first the lofts. Select the upper blue path in the middle (a simple straight line with the same height as the outline part of the actual loft) and create a loft. As Shape we take the great ellipse.

Now go into the modifier menu and scroll down to deformations (for a smoother look you can now set Shape Steps to 42 in Skin Parameters if ya want ;)

In deformations we click on fit and the following dialog appears:



Turn OFF 'Make symmetrical' and click 'Get Shape' - for the X-Axis (RED) use the front-shape and for the Y-Axis (GREEN) use the left-shape. For the wanted result you must rotate the shapes with the rotate arrows at the top of the window (one turn with the clock).

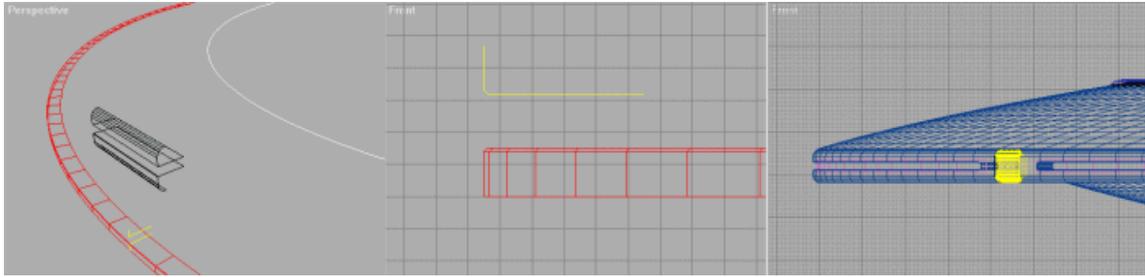


That's it, do this for the rest of the three lofts too and you got it (every has its own path and fit-shapes - only the loft-shape - the ellipse - is everytime the same). The pathsteps should be set as I told you already - part 1: 20 steps, part 2: 3 steps, part 3: 3 steps, part 4: 14 steps.

Don't forget to cap (close) only the upperst loft-part at the top and the lowerst loft-part at the bottom - the rest has to be open!

Now we make the extruded parts. We select the great ellipse, copy her and use the bevel modifier on her with the following settings: Cap Start/End both OFF, Bevel Values: Out0 ; L1: H14 Out0 ; L2: H1 Out-1 ; L3: H0 Out-40. You can see now it fits the yellow spline on the left side in the front view - zoom there ;)

These beveled part has to be mirror-copied so the copy fits the upper part of the yellow spline too.



Now the last part, so that we can close the saucer. Where is the hole, hm?

Unhide it, it's only the small ellipse attached to the great one and changed into a editable mesh. It closes the ring-hole between the 3rd and 4th loft part.

Now we move all parts together, like on the last pic, change one of them into a editable mesh, attach the 6 others to it, select all vertices (read lower in the tut how, where, aso.) and then weld them all together, with an weld-value smaller than 1, or the small edges will go away!!!

As you can see now, we got a optimized hull, at the edges round and smooth and with an optimum of used faces.

## Splinecage

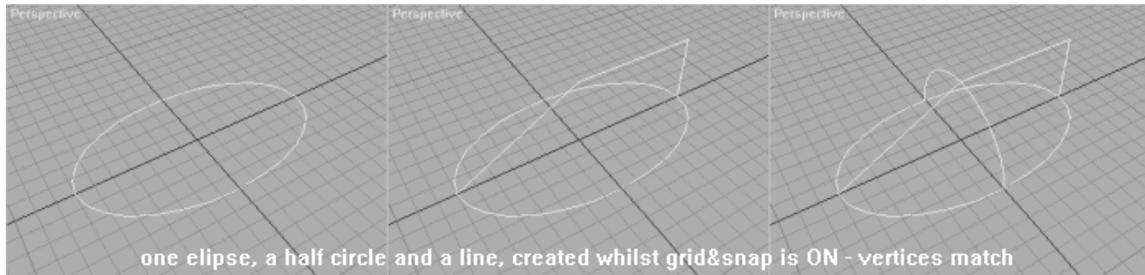
The surface-modifier changes a web of splines into a patchgrid. For creating the main lines - the splinecage - of the object we have two possibilities: CrossSection-Modifier, or more interesting for us, by hand. \*people which know me are now smiling ;)\*

For the CrossSection-Modifier I reference to the handbooks, the online help or my detailed tutorial about splinecage in german language at [www.3dmaxforum.de](http://www.3dmaxforum.de)

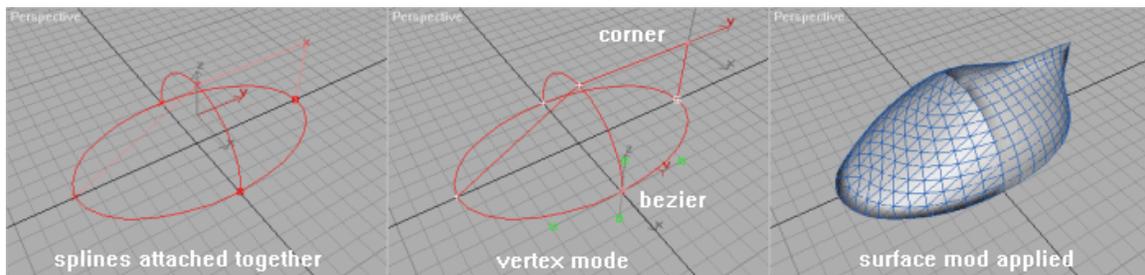
We'll handle now the by hand method. Now, that the surface-modifier can only place a patchgrid between three or four Vertices, you have to look that the splines only crossing at the vertices and that at least only three- or four-edge bordered faces will be built. Take care of the distance between the vertices of the splinecage. It should be greater than one max unit, cause the surface-mod welds vertices with a smaller distance than 0.5 together to one and your splinecage melts to something you don't wanted - try!

For a easy placing/constructing and a save welding of the right vertices during the surface process it's best to use the gridsnap turned ON. Now build your splinecage in 3D by creating lines which crossing

each other under the rules I'd given above. For smooth surfaces you naturally can make the vertices bezier (in subobject mode>rmb on vertex) and form the splineage to your objects needs.



A hint for best results: avoid three-edge bordered faces, cause the building of the patch at these faces results sometimes in surprising, not wanted surfaces like swellings, creases aso. At least attach all splines together to one and use the surface-mod on the splineage. For detailed informations about the settings and options reference the sources I'd allready mentioned above.

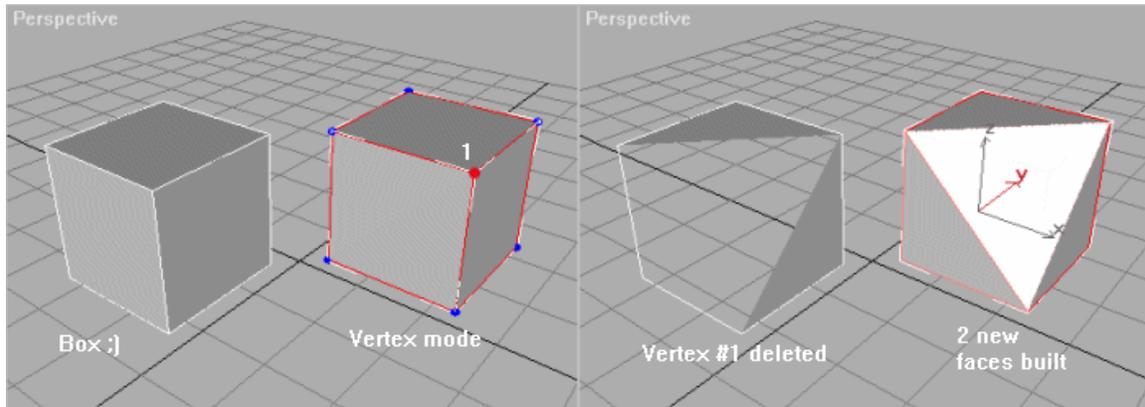


Keep in mind that splines do not cross - the segments going from one vertex to another, the splines itself (brighter red spline in first pic) aren't connected and don't need to be connected for the surface mod. The only thing they should be connected is visible in the second pic - if ya want smooth surfaces the vertices should be bezier and especially at a line, going troughrought, be welded, so that the surface later is smooth. This is visible on the last pic - the side vertex is bezier, the top ones a corner, so the hull gets a edge there.

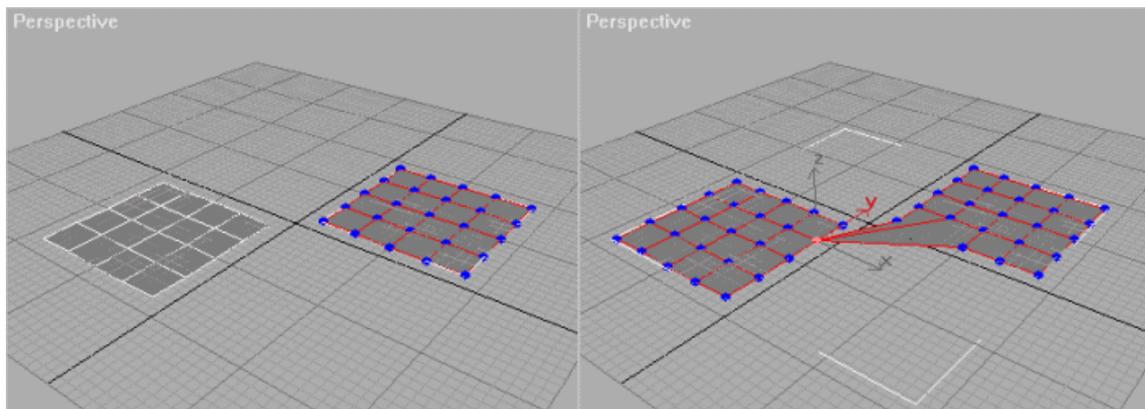
## MeshEdit

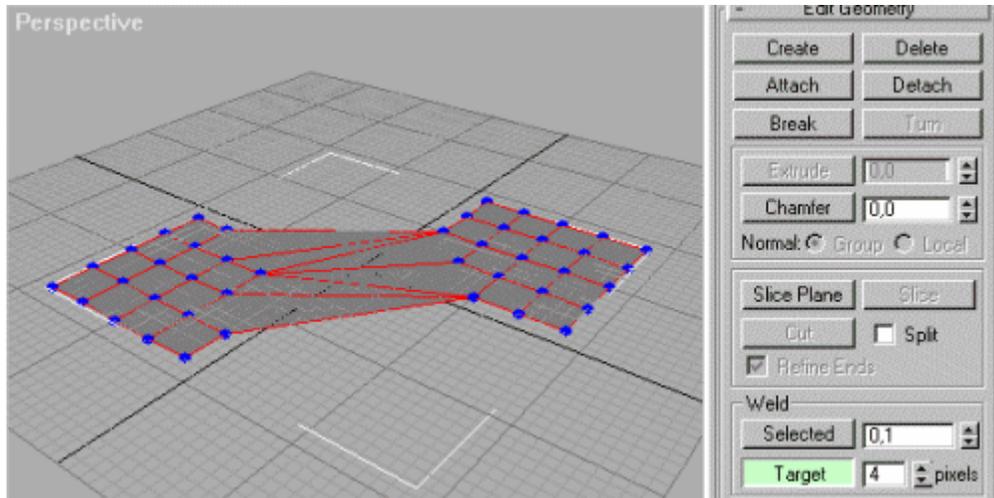
Now comes the 'hard' part for the boolean/primitive guys ;) At the beginning of this tut I'd spoken from hulls, hollow objects - it's time to look by yourself. Create a simple box and change it into a editable mesh (rmb or modify menu). Now go to subobject>vertex and select one of the edge vertices - delete it and switch the actual view to smooth&highlights. Now you can look into the hollow box. We

can now close this open box by creating faces to cover the hole (subobject>face>button 'create').

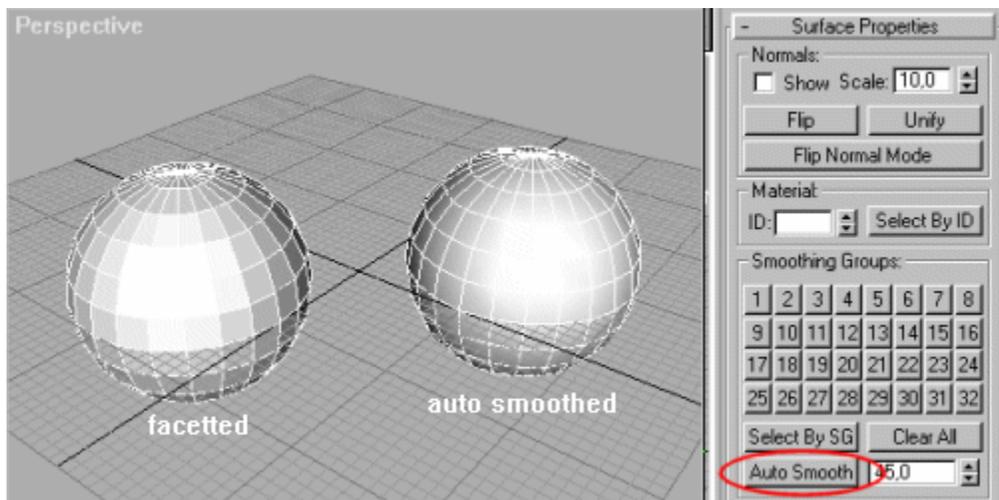


Ok, that was simple, now something other - create two planes, change one of them into editable mesh and attach the other plane to it. Go to subobject>vertex and click on the button 'target' in the weld-area. Take a vertex of plate number one, move it over a vertex of box two and drop it. This is best done in a perspective view, where you can see what happens. Now you'd made one vertex out of two - welded.



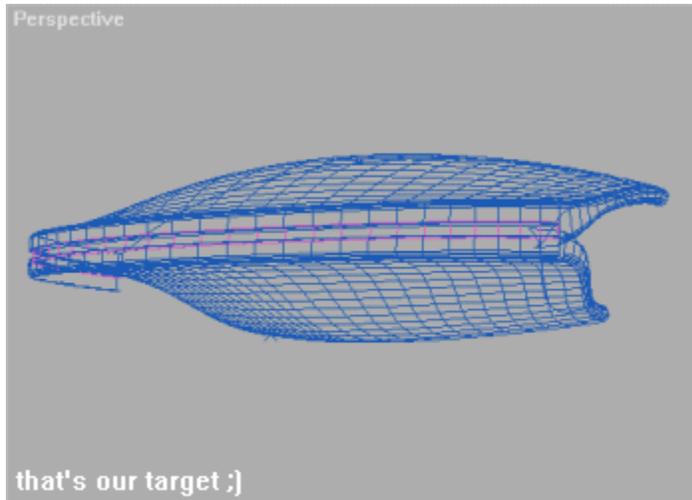


You can now try to close the rest of the open area between the two planes, so that you can see how to close holes between parts you can create via loft or splinecage. If the resulting surface of a 3D object (not these two planes here, more something round ;) in viewportmode 'smooth&highlights' looks faceted, mark all faces in subobject-mode 'face' and click the autosmooth button in the modify menu on the right side (scroll down to get there).



These 3 Cases: delete vertices, welding vertices and building faces are the main points for the last part I want to teach you. Especially welding vertices will be helpful to connect the parts we're creating with loft/splinecage.

## All Together

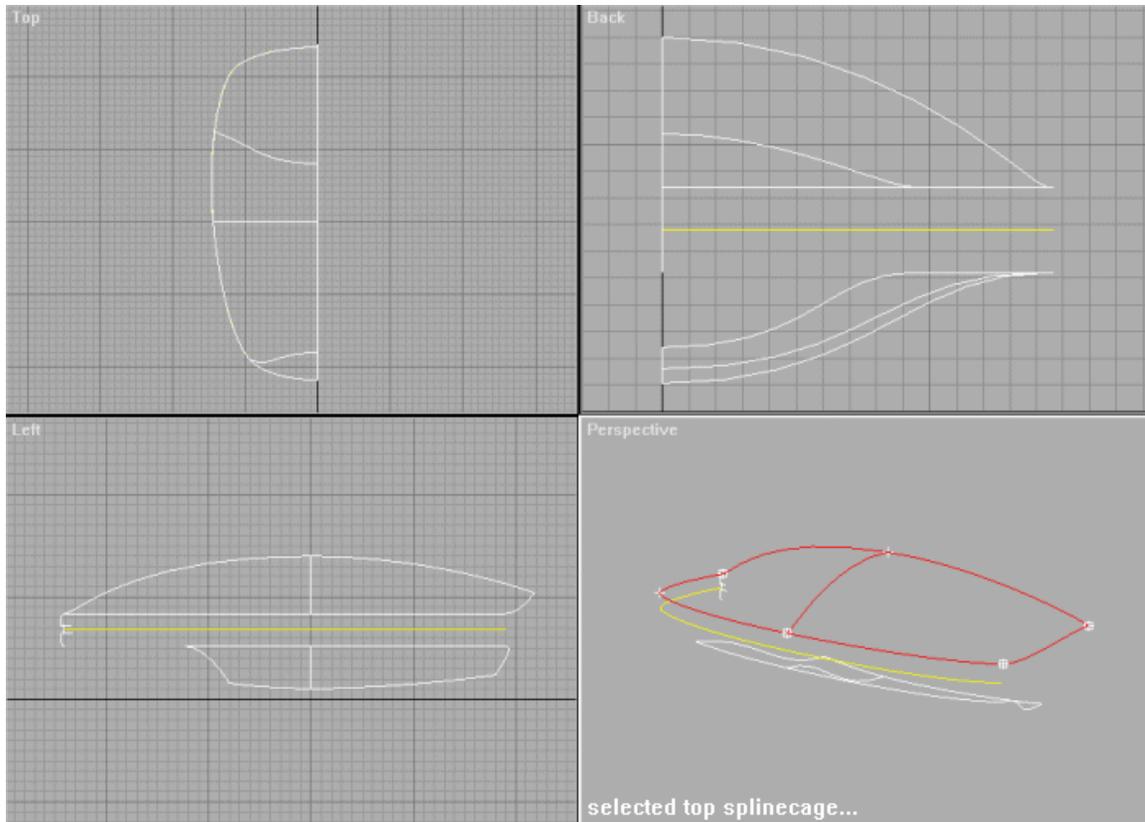


I'll show you now the power of this creating technic on the secondary hull of the nebula class. You'll create some lofts for the surrounding sensorstripes, the smooth edges between the hull and the navigation deflector and the upper and underside parts of the hull via splinecage and surface modifier. Then we'll weld the stuff

together and tweak it a bit, cause it has some holes we want to close...

At first we naturally draw the outline of the part we want. Here it's a bit different from the saucer, cause we want to use the surface modifier for creating parts of the hull, that's why we have to draw some of the splines in "3d". Don't forget to switch GridSnap ON for this kind of work, you already know why ;)

As you can see I'd already done the work for ya - or better telled - this is the same stuff out of that I created my nebula secondary...



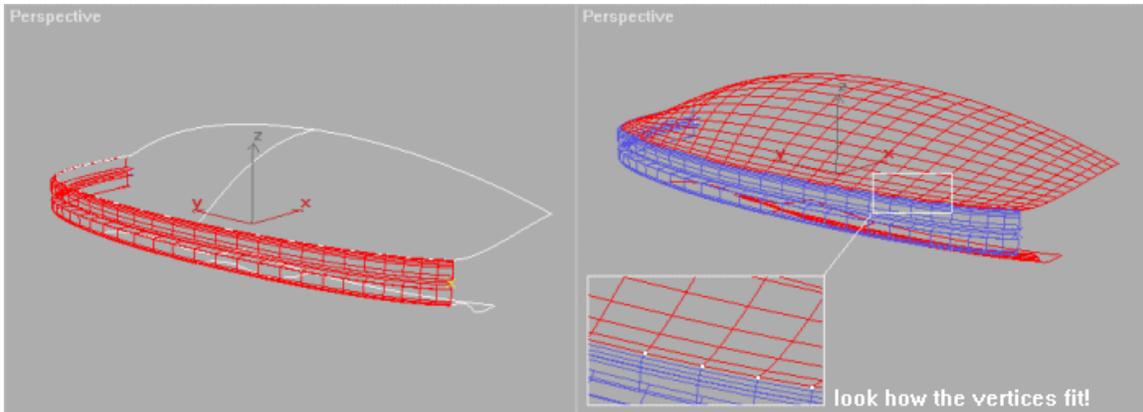
You noticed surely the tiling of the upper and lower splineage - 4 edge bordered faces.

But now some really important things. Do ya see the yellow spline between the two splineages? - this is the loft path for the sensor-stripe-boundary. It's a copy to the equal spline of the upper splineage and a splinepart of the lower part is equal to it too.

That's important, cause we want a perfect match for the splineage parts and the lofted boundary of the hull - you'll later see...

Now we do the loft. Select the yellow spline - the boundary path - and make it a loft. As Shape we'll take a spline I called: "Loft-Boundary-Shape" as instance. It's top and bottom ends are formed that way, that they later make a smooth transition to the splineages - the splineages have to be formed naturally the same way - I mean there's no angle between the handles of the endvertices - look yourself in subobject mode: vertex of them splines.

Ok, go in modifier menu and scroll down to Skin Params - set Path Steps to 12, Shape Steps to 3 and activate optimize Shapes (optimized path is very usefull for straight parts of the loft, which won't be bended later and it's only activable when in Path Params 'Path Steps' is activated).

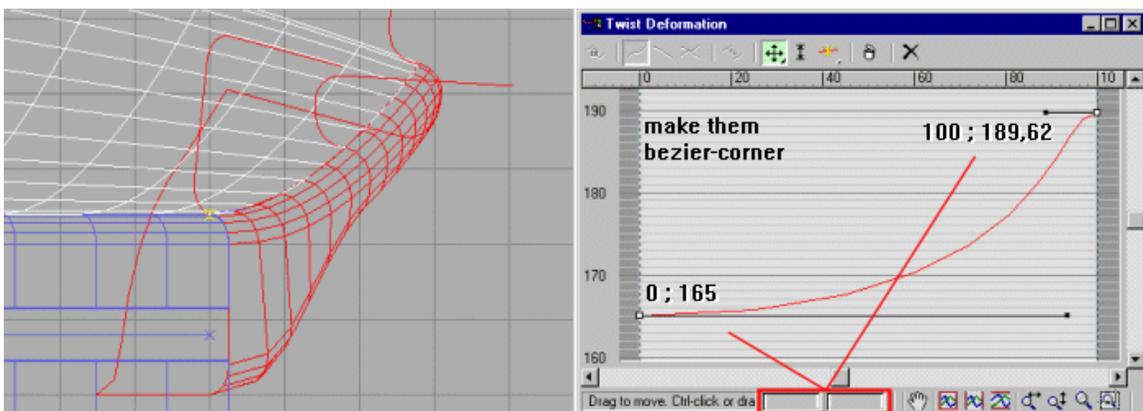


Now select the splinecages and apply the surface modifier on them with a step-value of 12. And, is that nothing? The splinecage now automatically fits the vertices of the boundary loft, the transition is smooth - naturally after we welded the parts together and applied the autosmooth ;)

Now there's only a hole in the bottom and the front left - first the front one...

Now unhide two splines called: 'Edge Shape SMALL' and 'Edge Shape BIG'. Then select the upper splinecage, go back to 'Line' in his stack, then activate subobject spline and you'll see that one spline is selected. Scroll down, detach it as a copy and call it 'upper path'.

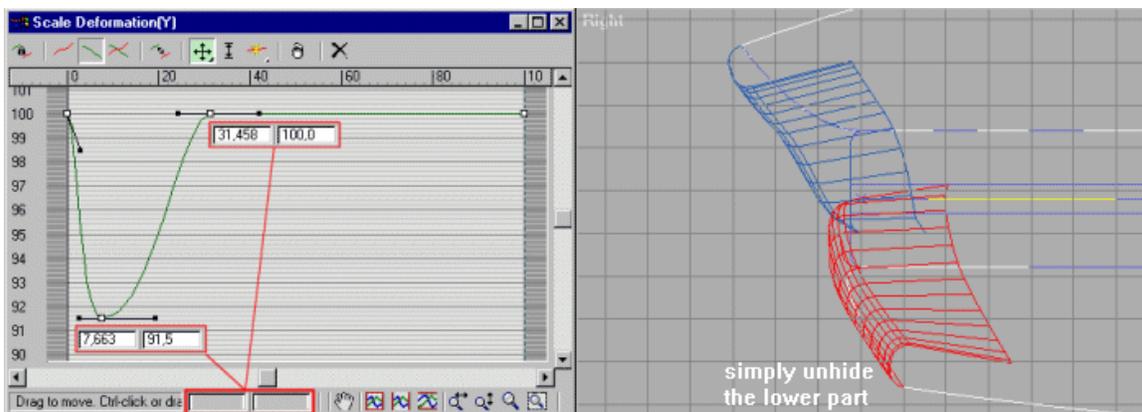
Now we make a loft with this path - get the 'SMALL' shape at first (naturally as instance). Then set Path Steps to 12, Shape Steps to 3, activate 'optimize Shapes', activate 'Path Steps' under Path Params and set 7 as value for the actual Path-Level - the yellow cross in the viewport is now at the middle of the path. Get again the 'SMALL' shape as instance. Then go to level 14 and get the 'BIG' shape as instance. The loft looks now like on the pic and we have to twist the shapes a bit - I'll give you the settings (look in pic), but for own projects you have to find these settings by yourself ;)



Under Deformations, click on Twist. The handles of the vertices had to be set like in pic. As you see now, the second 'SMALL' shape holds the cross-section of the loft down till path-step 7 and then it rises till step 14 to the size of the 'BIG' shape. The twisting itself has to be made, cause we wanted a smooth transition from the splineage to the loft. And you see a second thing - we used a spline of the splineage as a path for a loft - keep this in mind, cause it's very helpfull.

A little tweaking now for this loft - click on the 'Scale' deformation and set the green spline like in following pic. The outline get's a bit smoother because of this. The red spline has to be 100%, we only wanted a rescale of the shapes at the local y-axis of the shapes.

Ok, now you know the technic you can simply unhide the lower part of the edge - it's called: 'Lower Loft Edge' the creation process is equal to the upper part, only other shapes & settings for twist had been toked/made.

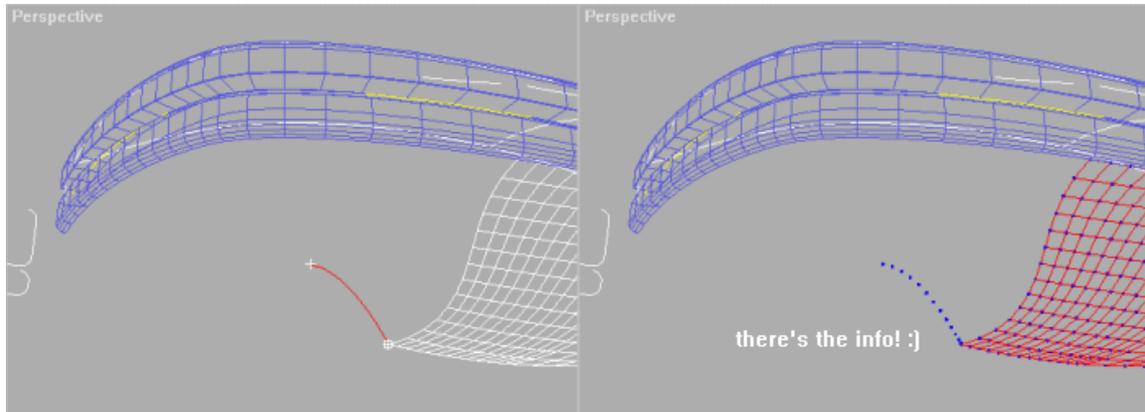


That was the front - the rest of the closure there does a loftet ring, some little parts and naturally the deflector, but this is a tutorial about a technic, not about a ship :)

We close the back-hole. Select the underside-splineage, in stack go to 'Editable Spline' and change into subobject mode: Spline. A spline allready is selected. Myself has used this spline again for a loft of a little circular shape, which builds the round edge on my nebula, but that's very tricky and later when we meshedit this section it need's care, so we make a much more simply variant here.

Select the copied spline, change into subobject mode: vertex and move the upperst vertex into the middle of the hull along the x-axis (btw: zoom till the grid has a value of 0.5 - I layed all vertices with snap on! - so you can move this vertex precise to the middle of the hull with the gridsnap - simply rezoom between moves). Move the

green ends of the handles of both vertices only along the x-axis, till the spline looks straight in front view - in side view it should keep it's form and look like on next pic (for this handle moving turn OFF gridsnap, it's easier that way ;)

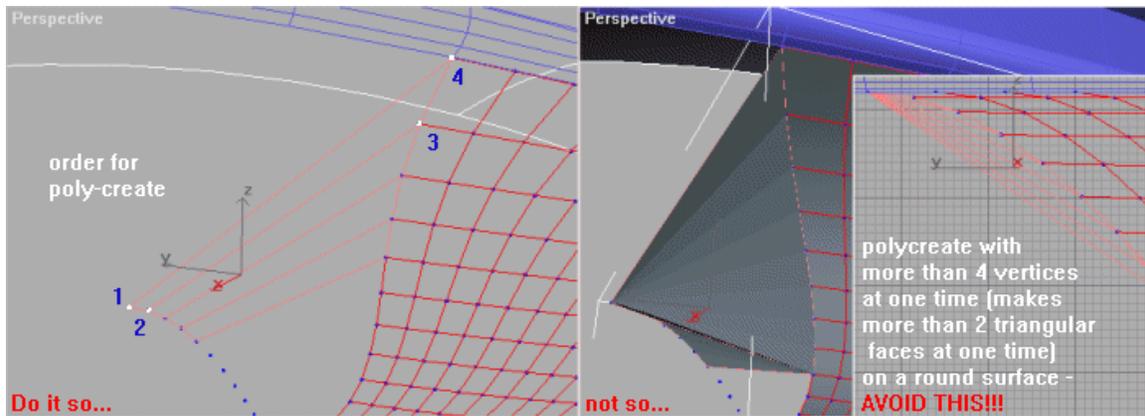


Now we close the whole thing - take care that the last spline has a steps-value of 12, it must fit the splinecage! Select the lower splinecage, attach a editable mesh modifier on it. Attach the spline to it. Looks like the spline disappeared, hm? But don't worry, the info we need is there :)

Go into subobject mode: vertex - and?.. hehe, that are the points which we need for making a good closure of this section via meshedit.

Change into subobject mode: Polygon and click the 'Create'-button. Click on vertex 1, then vertex 2, then vertex 3 and at least vertex 4 two times. This ends this polygon - or better creates two triangular faces in one step (you can look for this when switching into subobject mode: edge - see the triangular faces?).

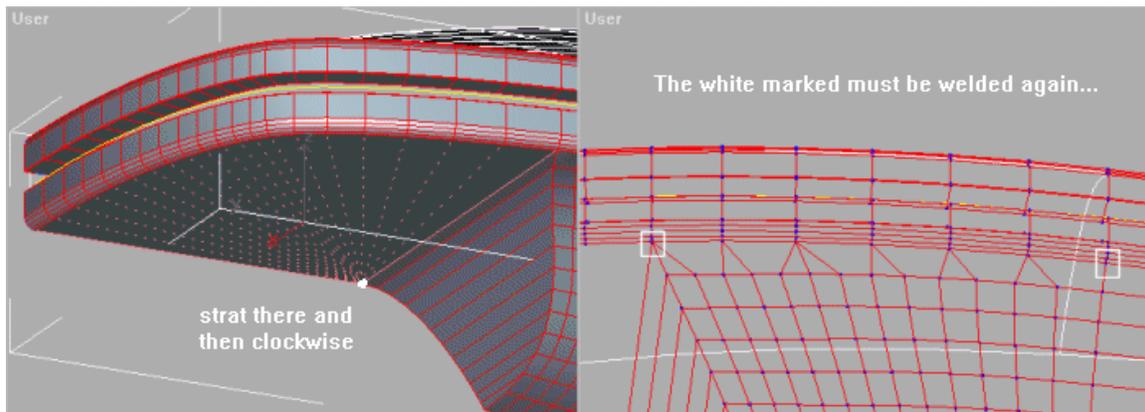
Take care of this thing, create only at flat surfaces more than two triangular faces at one time, or your surface will look wired. Try this, or simply look at following pic! The polygon-creator starts for all created triangular faces at your first vertex... seen it?



Now attach the boundary loft to it and build the rest of the faces - this time you can create more than two triangular faces at a time, cause it's 100% flat - thank our precision whilst creating the outline shapes with Gridsnap. I suggest to take the marked vertex as start (pic below) and then against the clock around, so the normals automatically point in the right direction...

Our next goal is to weld all vertices at the underside from the back-area till the front-area. The first ones we must use target weld, cause the position of the splinecage ones doesn't fit the ones from the loft, but this wasn't avoidable. More towards the front they do fit again.

For the target weld, pic the outer ones from the splinecage and weld them on the ones from the loft, how I did in the next pic.



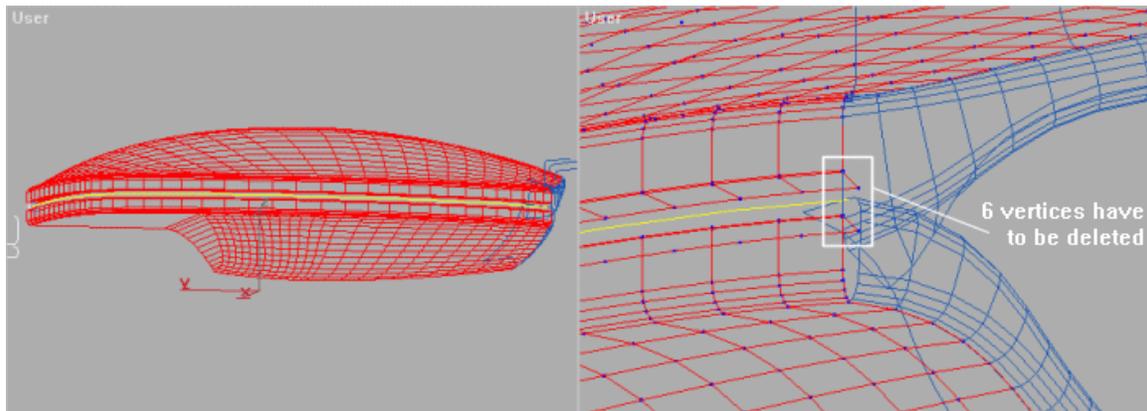
The left marked one, consist out of more then one vertex - select them with a boundary box and look at the counter under Selection in the modify menu. Then scroll down a bit, type in a weld value of '1' and click on 'Selected' in the weld-area. Do this with all other vertices from the ones I marked at the right side in the upper pic till the front.

Now attach the upper splineage part to the starting hull and do the same with the connecting vertices again...

You can test the weld value: "to small", "to big" by doing this - select all vertices and then click on weld. The number of vertices should have decreased, by the number of double vertices - the connecting ones. It should be 'selected number' minus  $[(3*12+5)=41]$  ... or something in this area, I had a loss of 41 vertices with a weld value of 0,1 - that shows you how good the vertices already fit :)

Three times 12 comes from the path steps, which had been 12 and the 5 extra points are the start-end vertices of the lines from the splineage, with one overlapp - else it would be 6 ;)

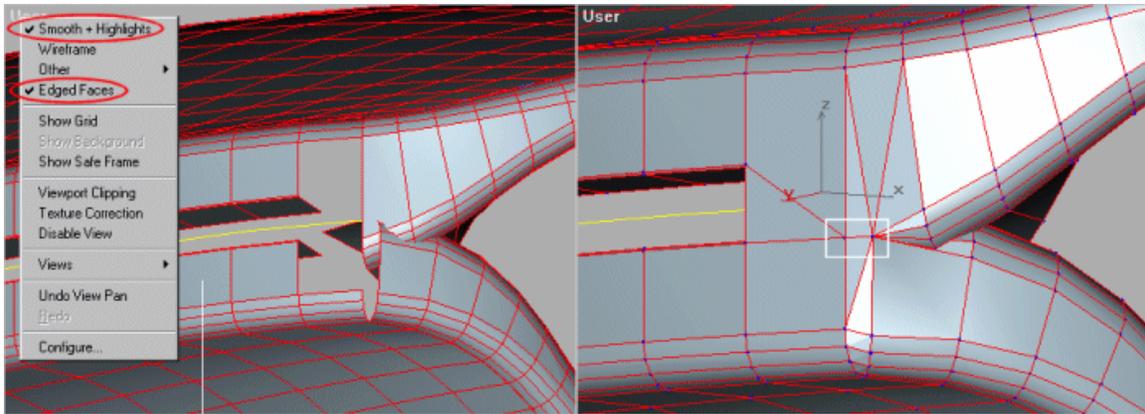
This is the easy way with the risk of welding vertices which shouldn't. So take care of the weld value. Your mesh should now look like next pic...



The front, zoom there and delete the marked vertices. Now attach both lofted edges to it. Switch in Smooth&Highlights modus and turn on edged faces for user viewport - this way it's easier to see what we do ;)

Clean the area if needed and then build new polygons and faces like I did in next pic - avoid to create double faces or such things, don't worry, if this happens you'll surely recognize when rendering the area after applying smoothing groups.

Now select the marked vertices (which you see in next pic) and move them a bit upwards, so that they describe a straight horizontal line.



We come to the final stage.. select again all vertices and weld them with a value of 1 - the number of selected vertices must decrease by 32.

Now switch to subobject: Faces and select all. Scroll down in modify menu and click on Autosmooth. That's it. Switch off edged faces for the actual viewport and rotate the mesh around with the mouse... ready.

I thank for your attention. End of transmission. The normal program continues now...

