



CATIA V5 Training Exercises

Cloud to Surface

Version 5 Release 19
January 2009
EDU_CAT_EN_CTS_FX_V5R19

Student Notes:

Table of Contents

■ Cloud data preparation	3
◆ Do It Yourself	4
■ Surface based approach	7
◆ Do It Yourself	8
■ Curve based approach	18
◆ Do It Yourself	19
■ QSR Network approach	30
◆ Do It Yourself	31
■ QSR Automatic approach	36
◆ Do It Yourself	37

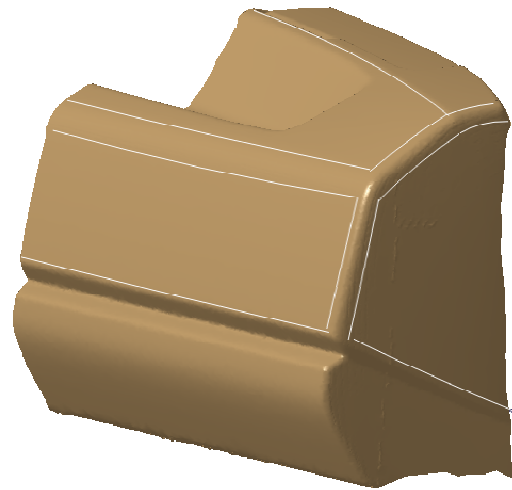
Cloud data preparation

Phase 1



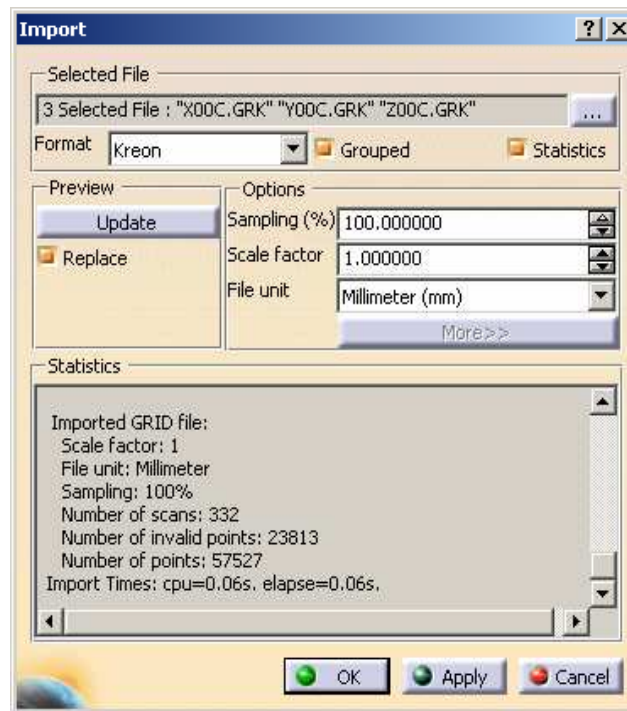
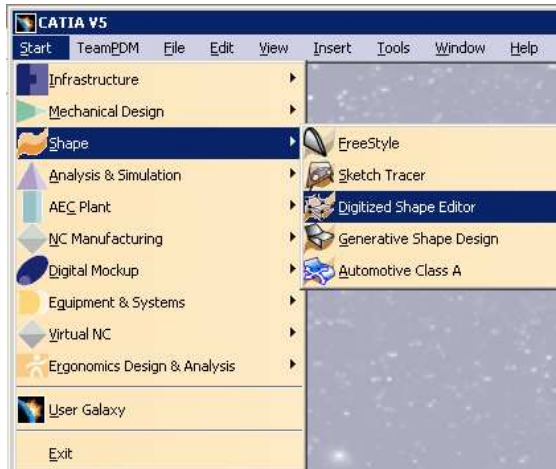
In this exercise you will:

- Import a cloud of points and prepare it for the following design work. This preparation consists in reducing the number of points in a way that preserves the quality of the shape description











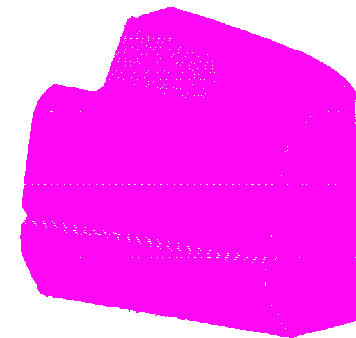
Student Notes:

Do It Yourself (1/3)

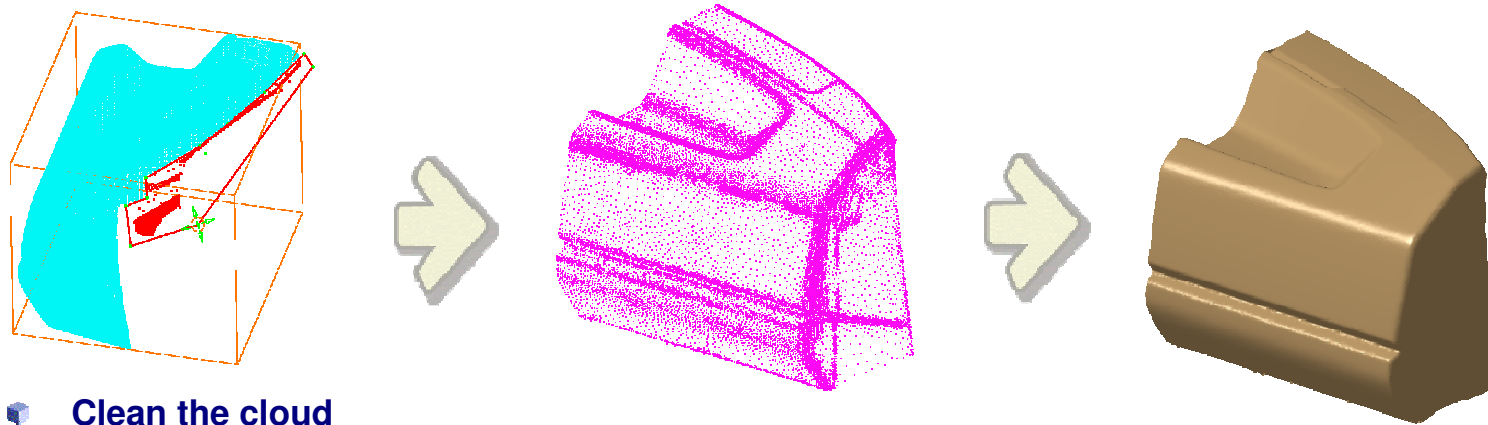


 Download on your disc the 3 cloud of points : Clouds.zip

-  Open a Digitized Shape Editor workbench
-  Import the cloud of points
 -  Import 
 -  Select files x00c.grk, y00c.grk, z00c.grk (Kreon format)
-  Change the display of the cloud
 -  Tools> Options> Shape> Digitized Shape editor> Display Modes
 -  Activate point option and deactivate polyline option



Do It Yourself (2/3)



- Clean the cloud

- ◆ Remove 
- ◆ Use a trap to remove unnecessary points

- Filter the cloud

- ◆ Filter 
- ◆ Choose the adaptative type, with a value of deviation that preserves the shape definition (example: 0.02mm)

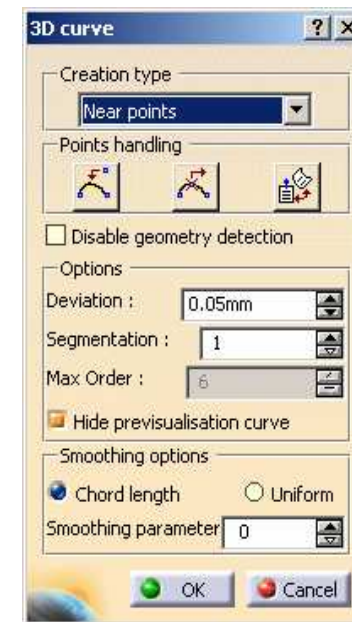
- Create a triangular mesh

- ◆ Mesh creation 
- ◆ Use the 3D mesher and tune the neighbourhood parameter
- ◆ Suppress holes by Fill Hole  or Interactive Triangle Creation  to suppress holes
- ◆ Remove unnecessary triangles if any 

Do It Yourself (3/3)



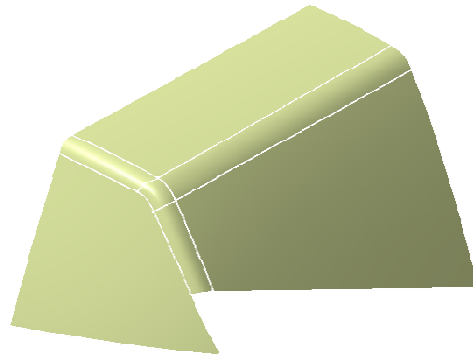
- **Open a FreeStyle workbench**
 - ◆ **Start/Shape/FreeStyle**
- **Create curves**
 - ◆ **3D curves** 
 - ◆ **Choose type Near Points**
 - ◆ **Select points on the mesh to create curves**



 You can load: 01_Mesh_BaseCurves.CATPart

Surface based approach

Phase 2



In this exercise you will:

- See how to create surfaces from a cloud of points in a surface based approach.

Characteristics of the surface based approach:

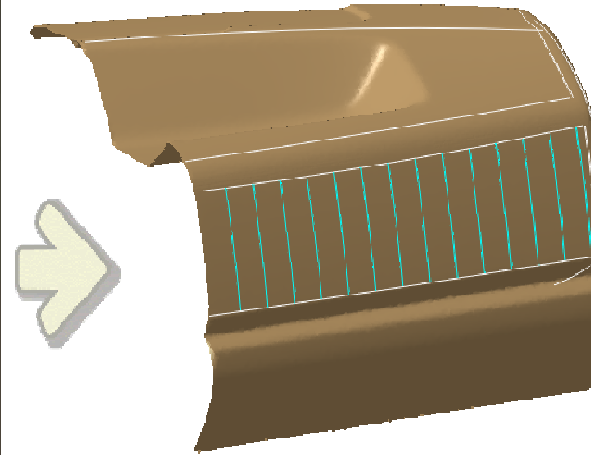
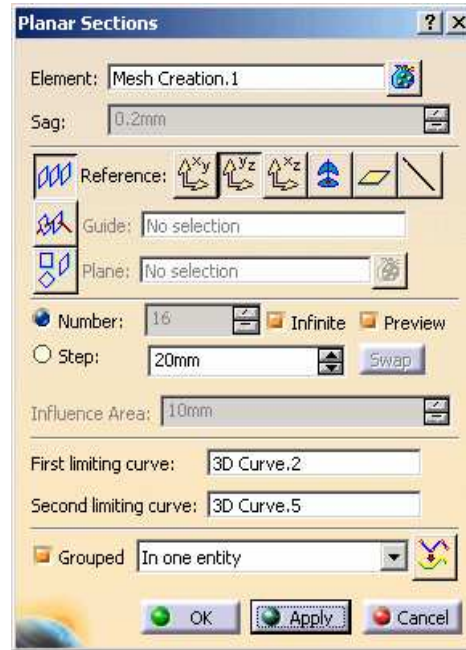
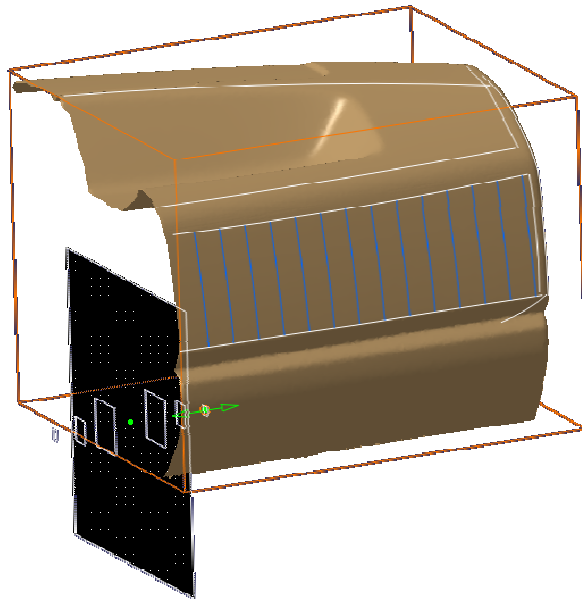
- Intuitive creation of surfaces
- Full control of shape via control points
- Real time feed back thanks to analysis tools
- Efficient for quick surface creation (no strict accuracy expected)


Drawbacks:

- Some practice of control point manipulation required
- Time and skills required grow very fast with expected quality
- No associativity to support design changes

Student Notes:

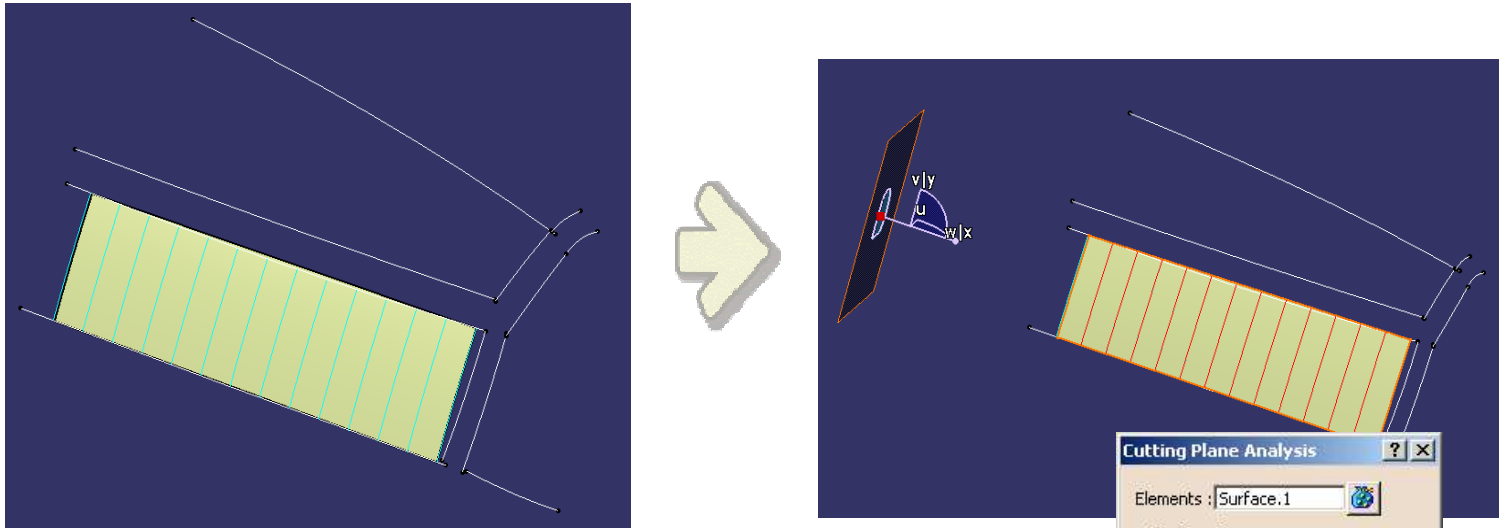
Do It Yourself (1/10)





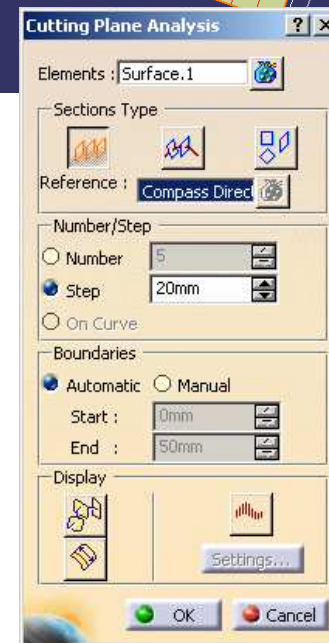
- ❏ Return to a Digitized Shape Editor workbench
- ❏ Create scans for first base surface
 - ❖ Planar sections 
 - ❖ Choose direction, step (20 mm), limit curves
- ❏ Hide the mesh

 Load: 01_Mesh_BaseCurves.CATPart

Do It Yourself (2/10)



- Return to a FreeStyle workbench
- Create a basic patch
 - ◆ 4-Point patch 
 - ◆ Select points on the curves
- Apply a planar section analysis to the patch
 - ◆ Cutting planes 
 - ◆ Use same location, direction and step as for the scans

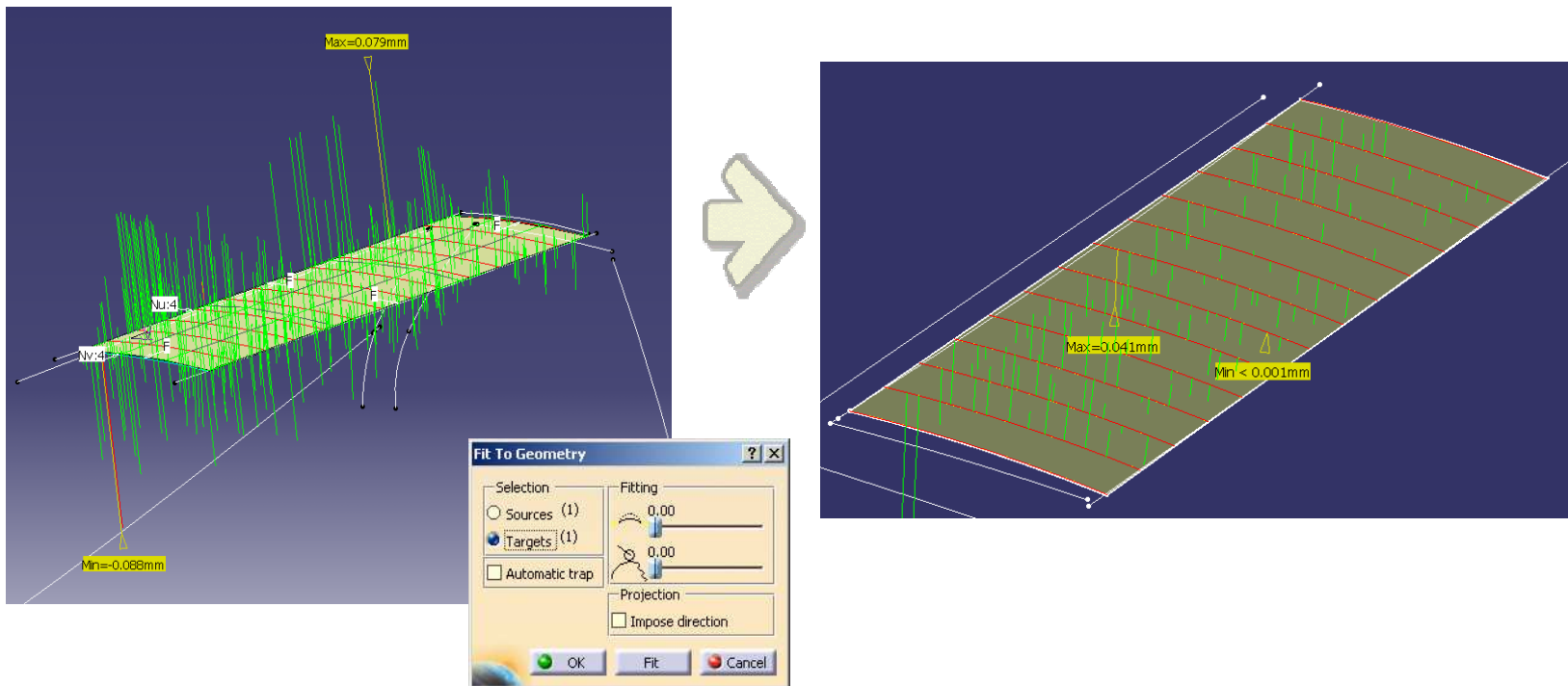


Do It Yourself (3/10)

The image shows a 3D CAD environment with a surface model. The 'Control Points' dialog box is open, showing various options for fitting a surface to a cloud. The 'Distance' dialog box is also open, showing the 'Color scale' section. A small 'Distance.1' dialog box is also visible, showing a color scale for the distance analysis.

- **Fit the basic patch to the cloud manually**
 - ◆ **Control points**
 - ◆ **Modify the control points (normal direction) to superimpose the sections with the scans**
- **Measure the deviation**
 - ◆ **Distance analysis**
 - ◆ **Measure the deviation between the surface and the cloud**

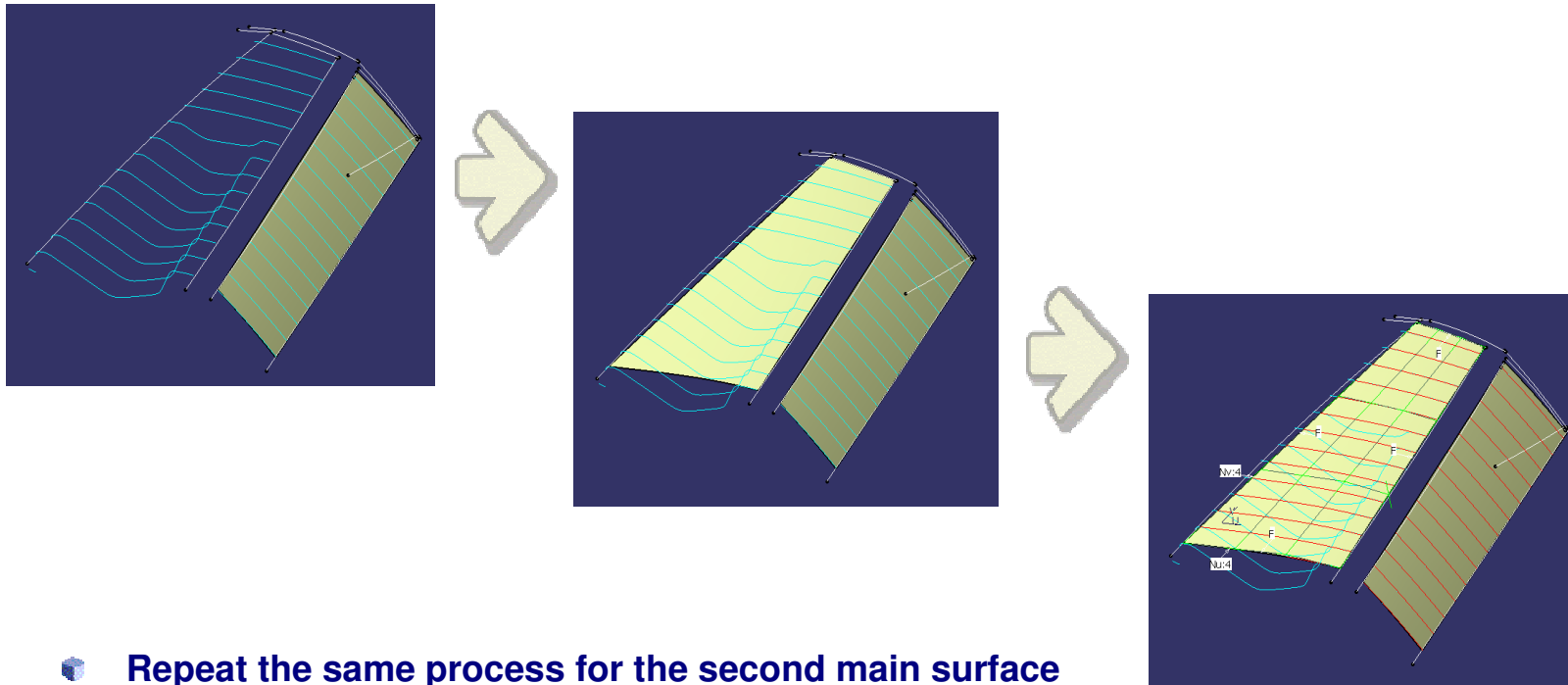
Do It Yourself (4/10)








- Fit the basic patch to the cloud automatically**
 - ◆ Fit to geometry
 - ◆ Fit the surface to the scans
- Check the surface quality**
 - ◆ Control points
 - ◆ Correct control points if their distribution has become irregular

Student Notes:

Do It Yourself (5/10)

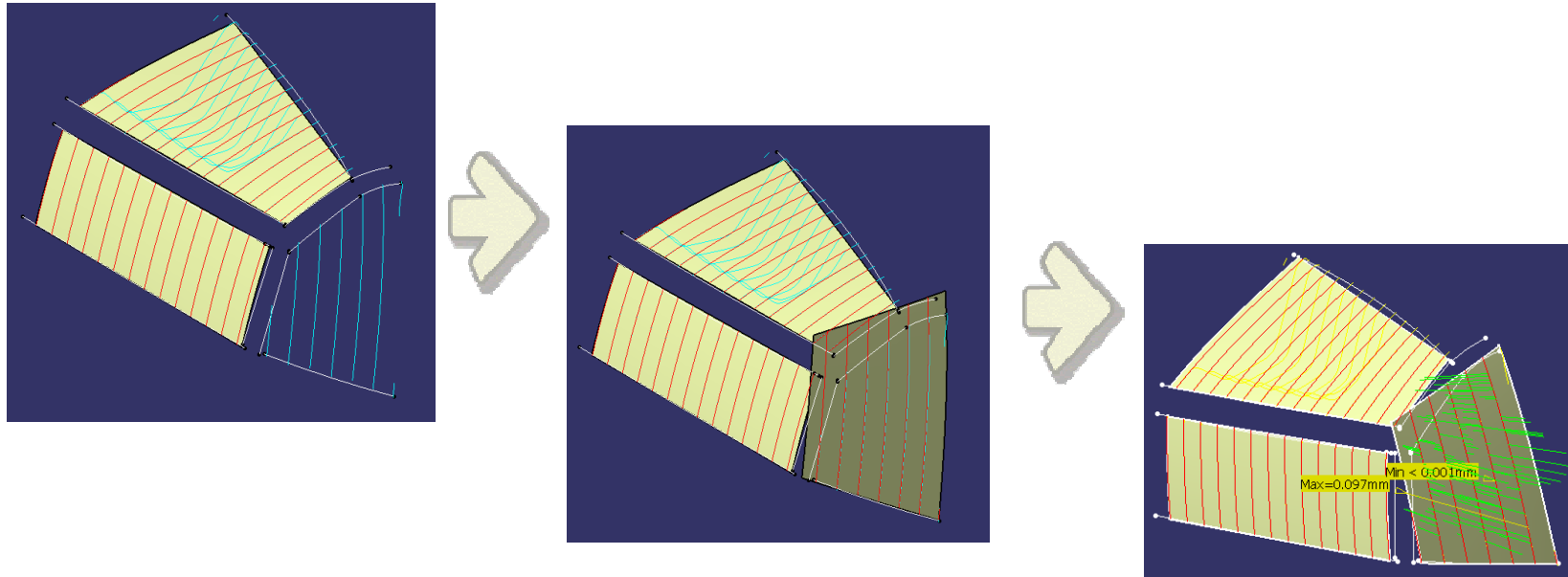


Repeat the same process for the second main surface







- ◆ Planar sections 
- ◆ 4-Point patch 
- ◆ Cutting planes 
- ◆ Control points (for manual fitting to scans outside the pocket area) 
- ◆ Distance analysis (ignore the distance in the pocket area) 

Student Notes:

Do It Yourself (6/10)



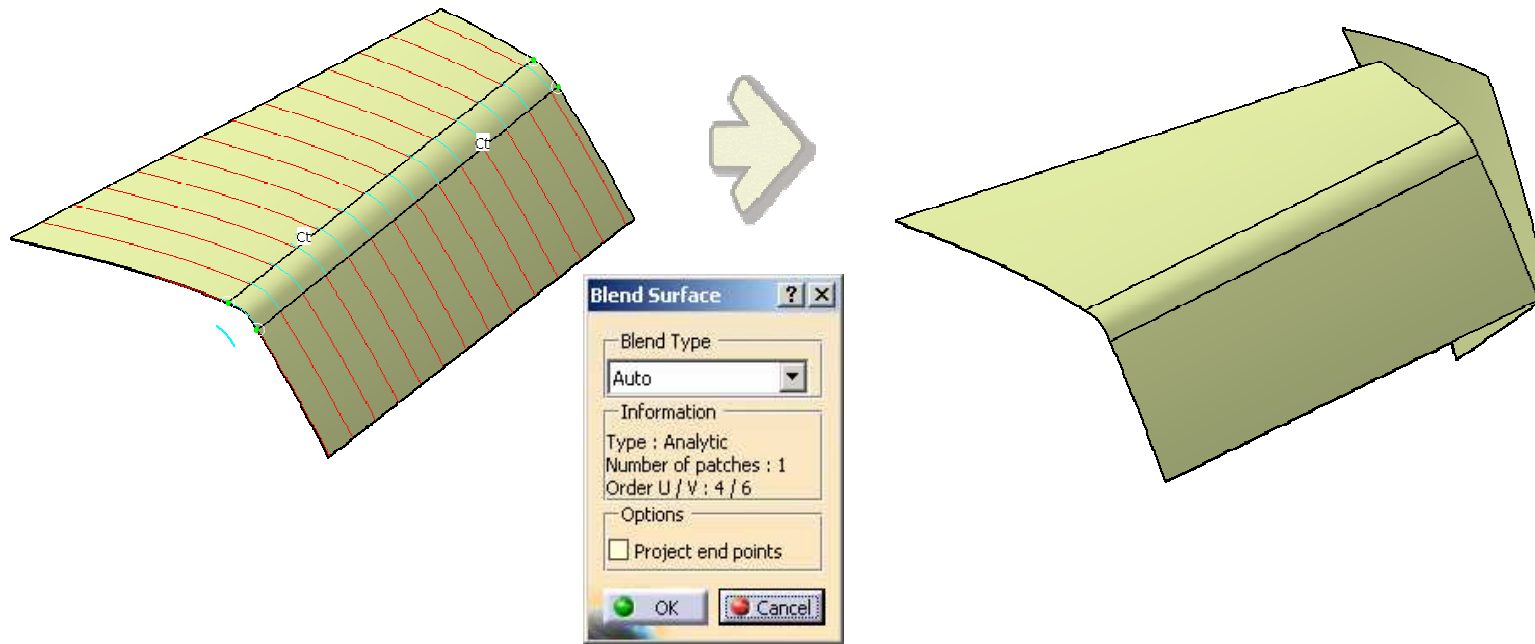
Repeat the same process for the third main surface

- ◆ Planar sections 
- ◆ 4-Point patch 
- ◆ Cutting planes 
- ◆ Control points 
- ◆ Distance analysis 
- ◆ Fit to geometry 

 You can load: 02_BasePatches.CATPart

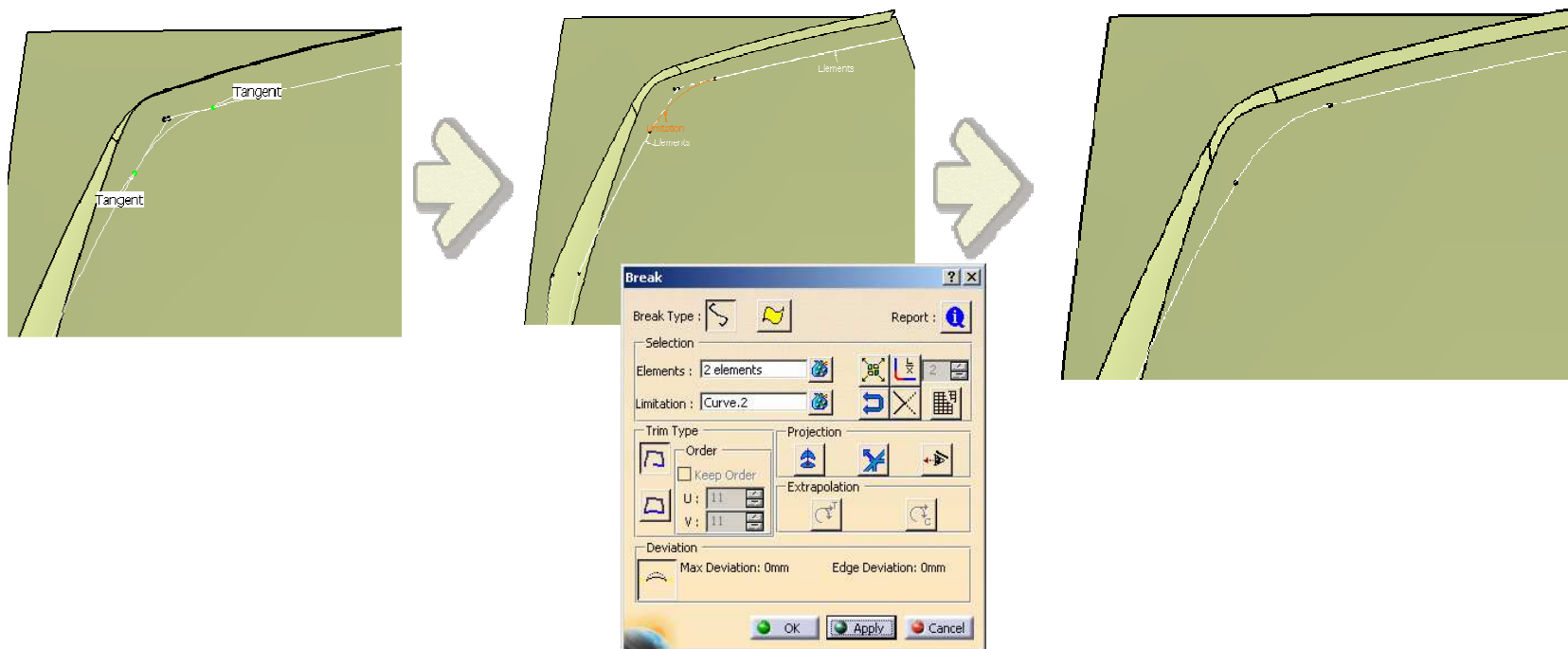
Student Notes:



Do It Yourself (7/10)



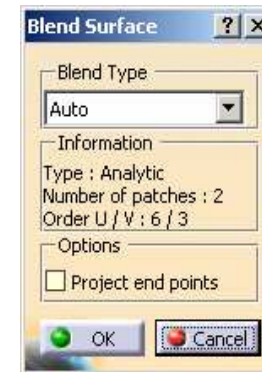
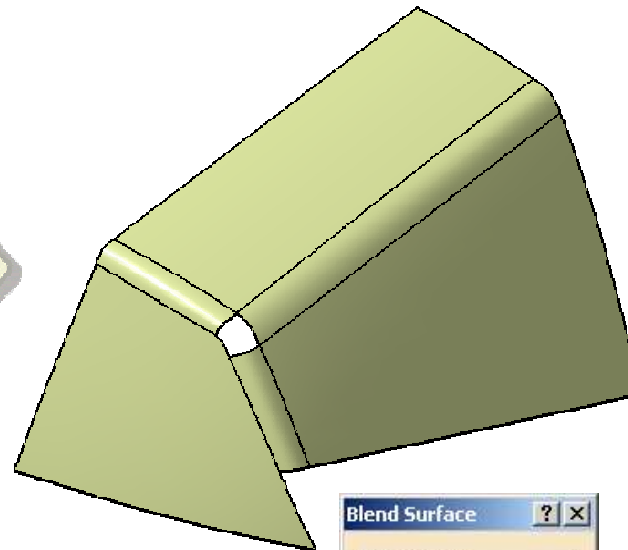
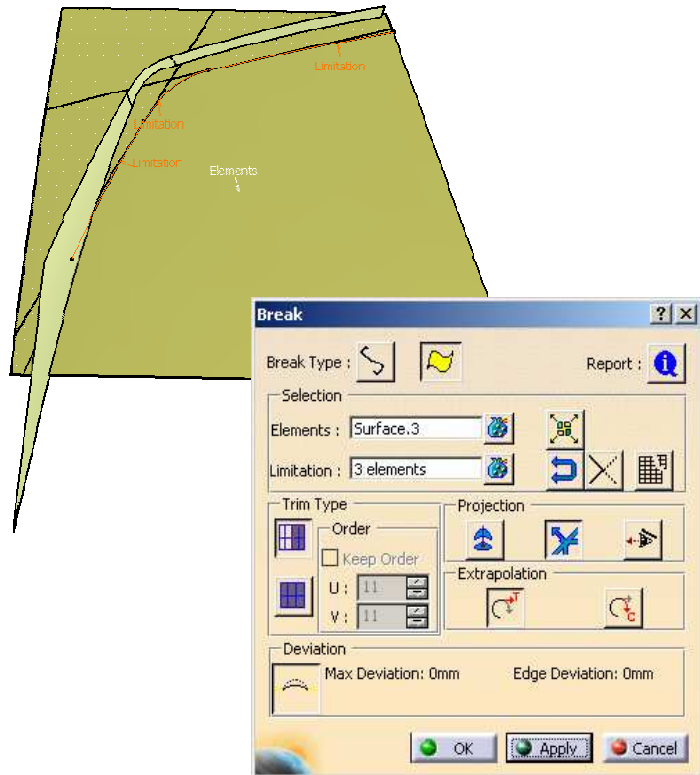
- ◆ Blend the first two main surfaces
 - ◆ FreeStyle Blend Surface 
 - ◆ Display continuities and tensions to tune the blend surface

Do It Yourself (8/10)



- ◆ Create trimming curves on the third main surface
 - ◆ FreeStyle Blend Curve 
 - ◆ Display continuities and tensions to tune the blend surface
- ◆ Break the trimming curves on the third main surface
 - ◆ Break curve 

Do It Yourself (9/10)



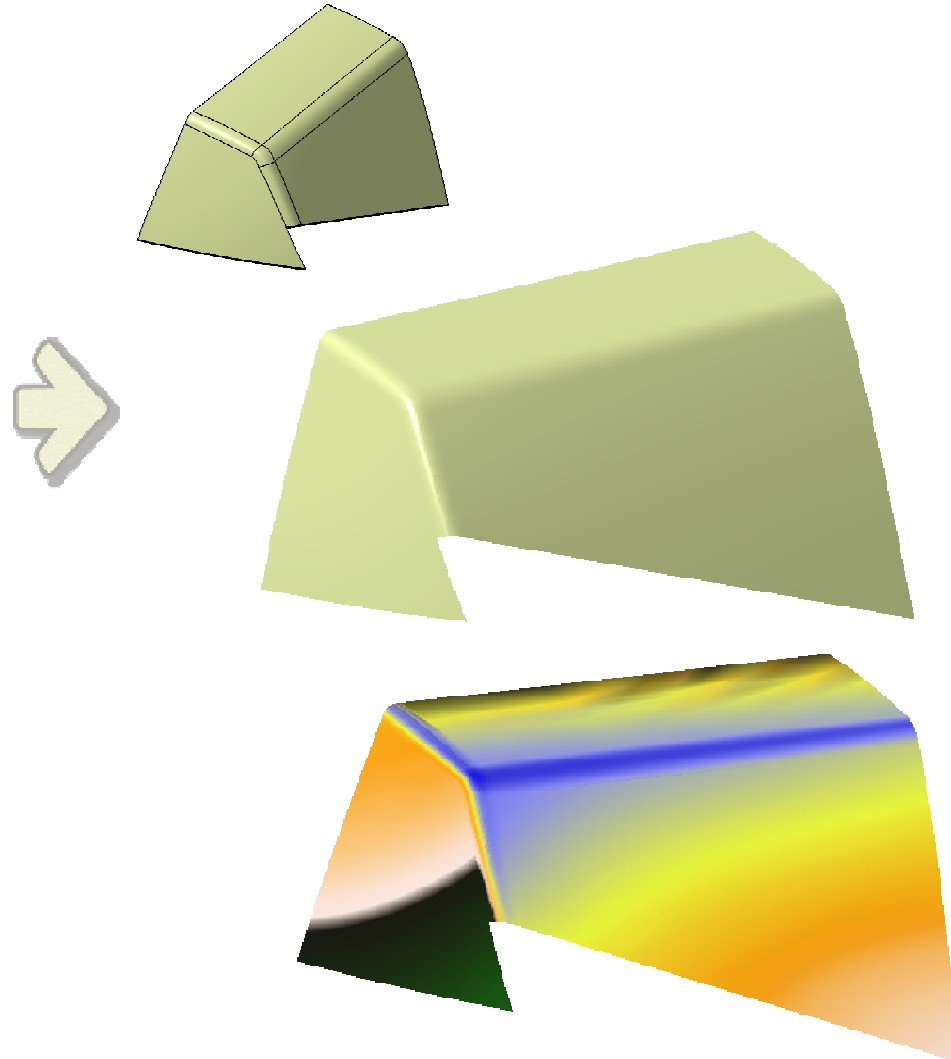
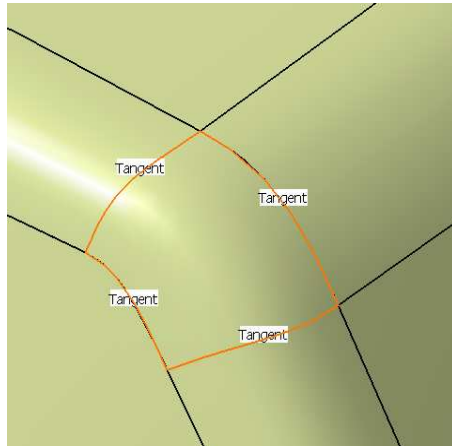
● Break the third main surface

◆ Break surface 

● Blend the main surfaces

◆ FreeStyle Blend Surface 

Do It Yourself (10/10)



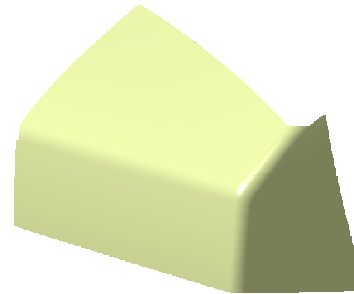
 **Fill the remaining hole**

 **Fill** 

 You can load: 03_End_of_SurfaceBased.CATPart

Curve based approach

Phase 3



In this exercise you will:

- See how to create surfaces from a cloud of points in a curve based approach.

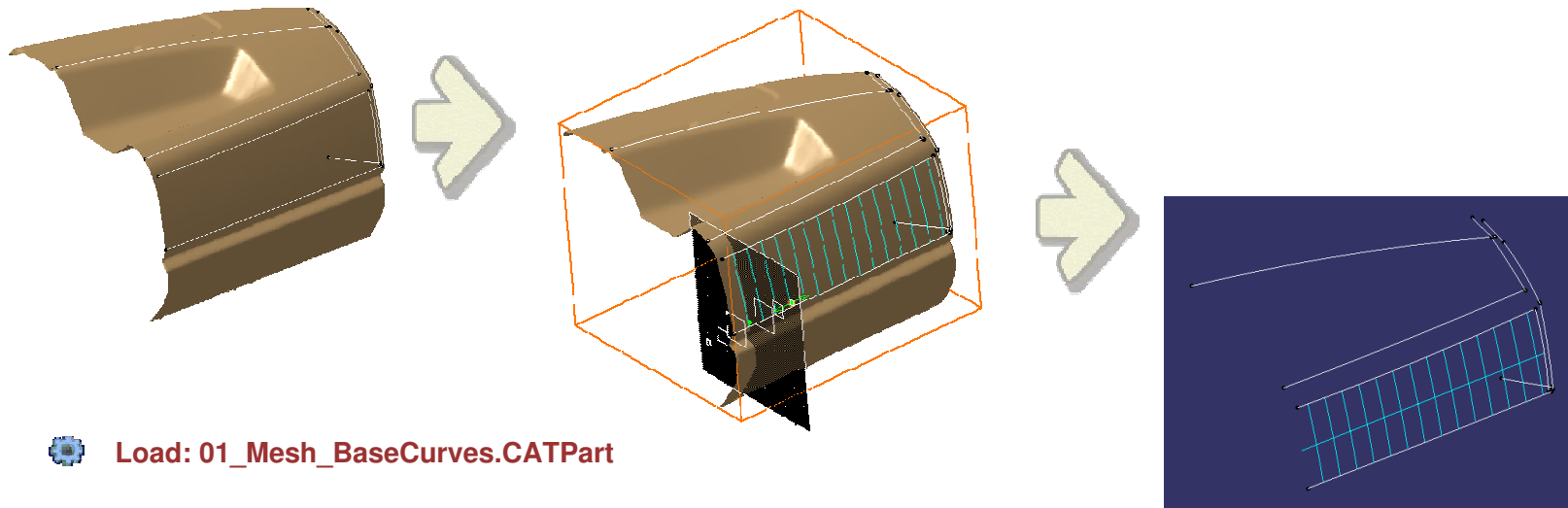
Characteristics of the curve based approach:


- Strict control of shape via their input curves
- Feature approach (associativity between surfaces and curves)
- Efficient for quality surface creation (strict accuracy expected)
- The quality of surfaces relies on the quality of input curves

Drawbacks:

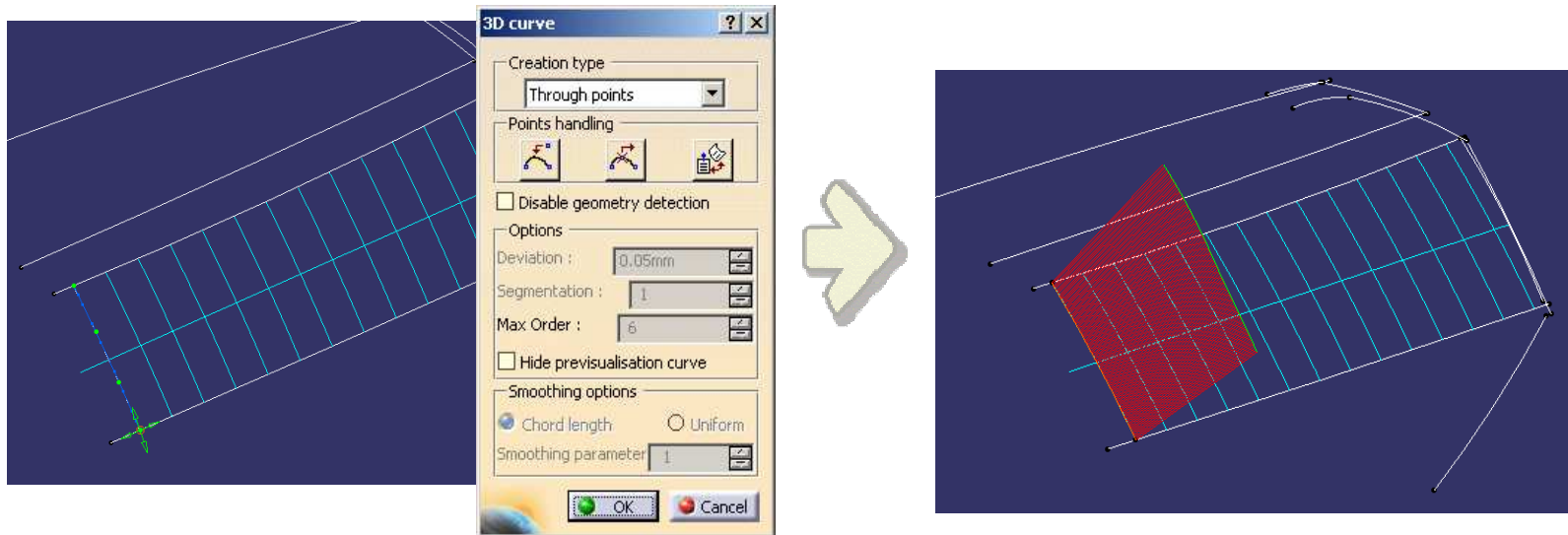
- Abstract approach, with some geometric knowledge required
- Less efficient for quick design because of time needed for curve creation



Do It Yourself (1/11)



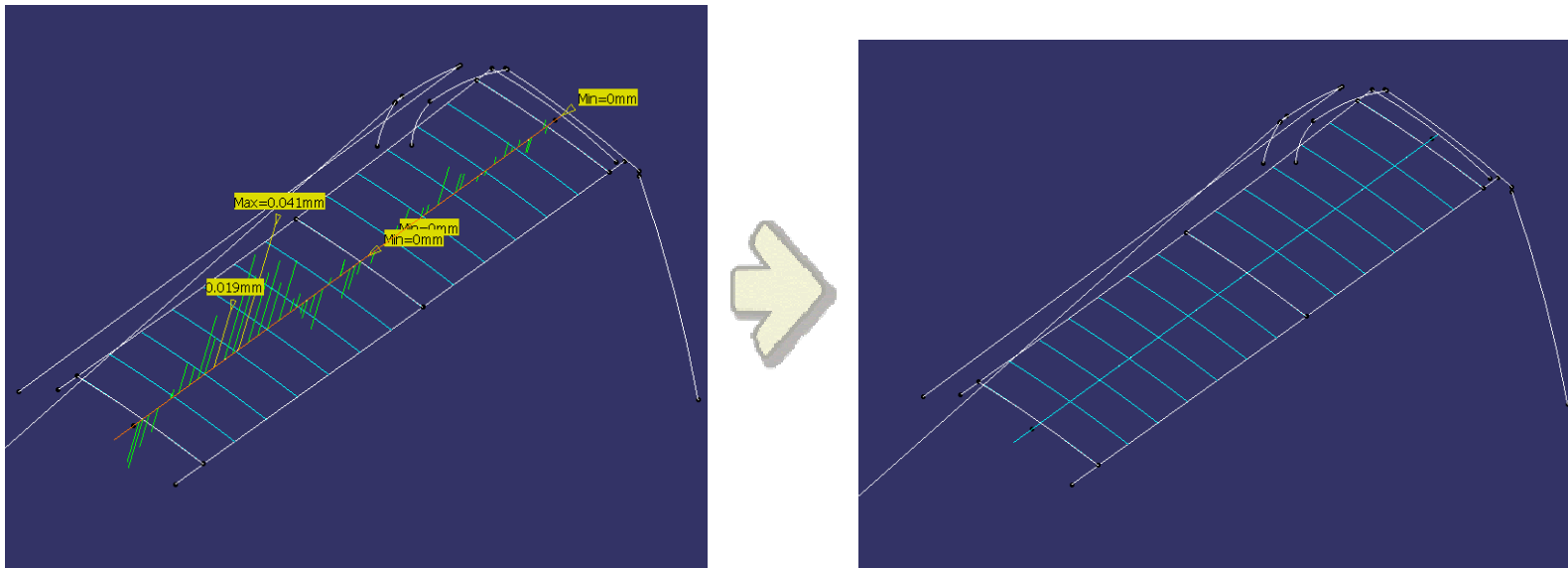
- Return to a Digitized Shape Editor workbench
- Create scans for first base surface
 - ◆ Planar sections 
 - ◆ Choose direction, step, limit curves
 - ◆ Also create one plane in the perpendicular direction
- Hide the tessellated cloud



Do It Yourself (2/11)



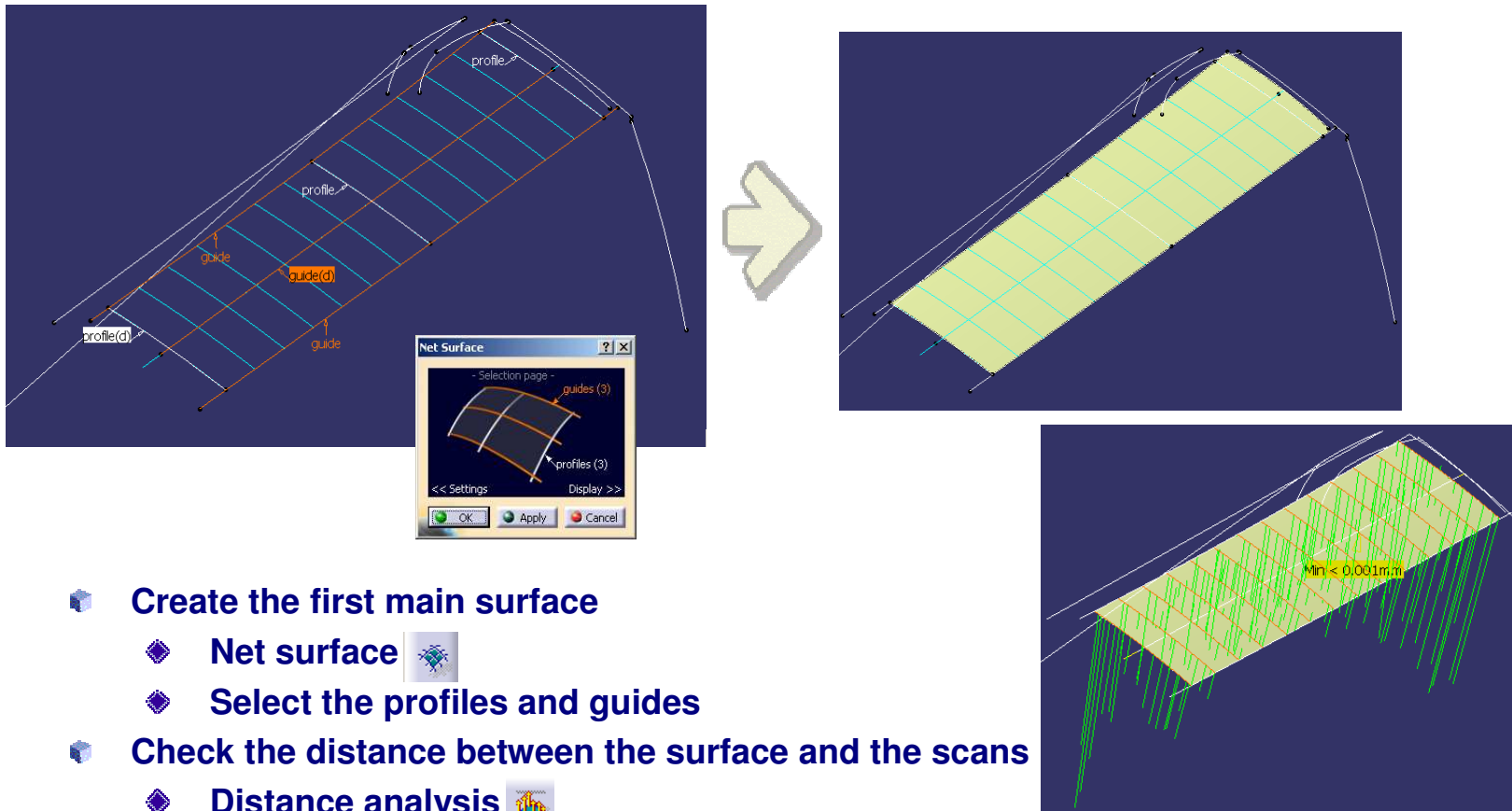
- ❖ Return to a FreeStyle workbench
- ❖ Create a curve on the first scan
 - ◆ 3D Curve 
 - ◆ Select Through Points and pick some points on the scans
- ❖ Check the curve quality with a curvature analysis
 - ◆ Porcupine curvature analysis 
 - ◆ Select the curve and check that its curvature is regular (otherwise change it or start again a new curve)

Do It Yourself (3/11)



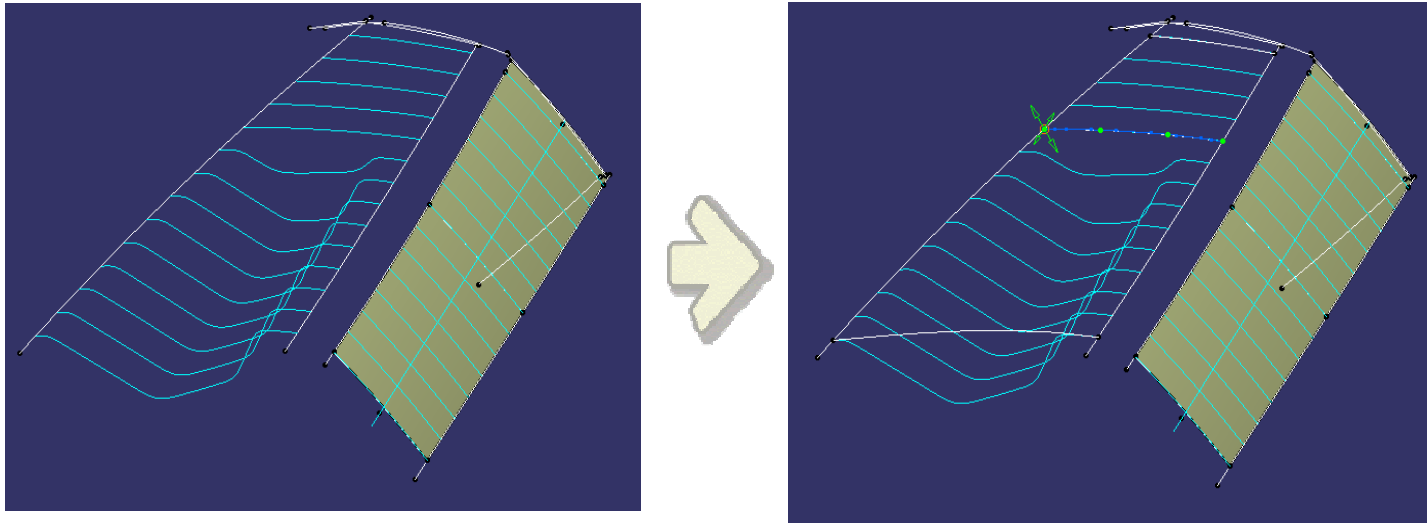
- Create curves on other scans (same method)
 - ◆ 3D Curve 
 - ◆ Select Through Points and pick some points on the scans
- You may also check the distance between the curves and the scans
 - ◆ Distance analysis 




Do It Yourself (4/11)



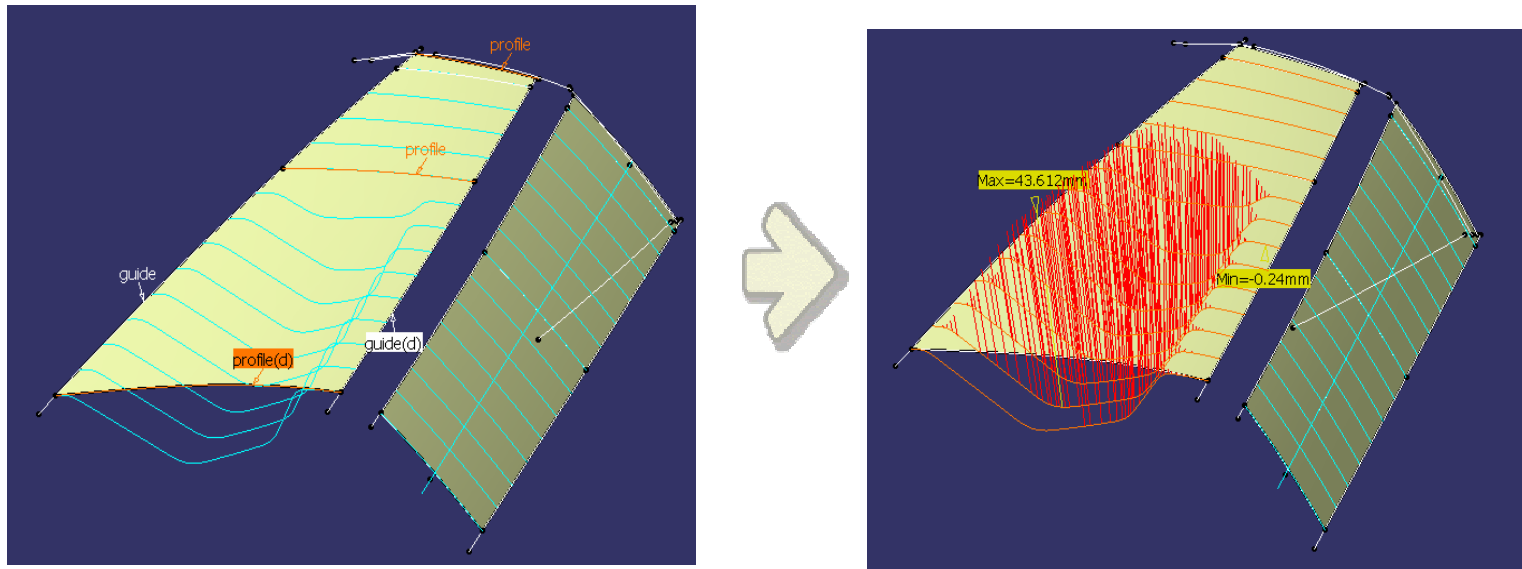
- Create the first main surface**
 - Net surface**
 - Select the profiles and guides**
- Check the distance between the surface and the scans**
 - Distance analysis**
- If the expected accuracy is not reached, create more profiles and edit the net to add them**

Do It Yourself (5/11)



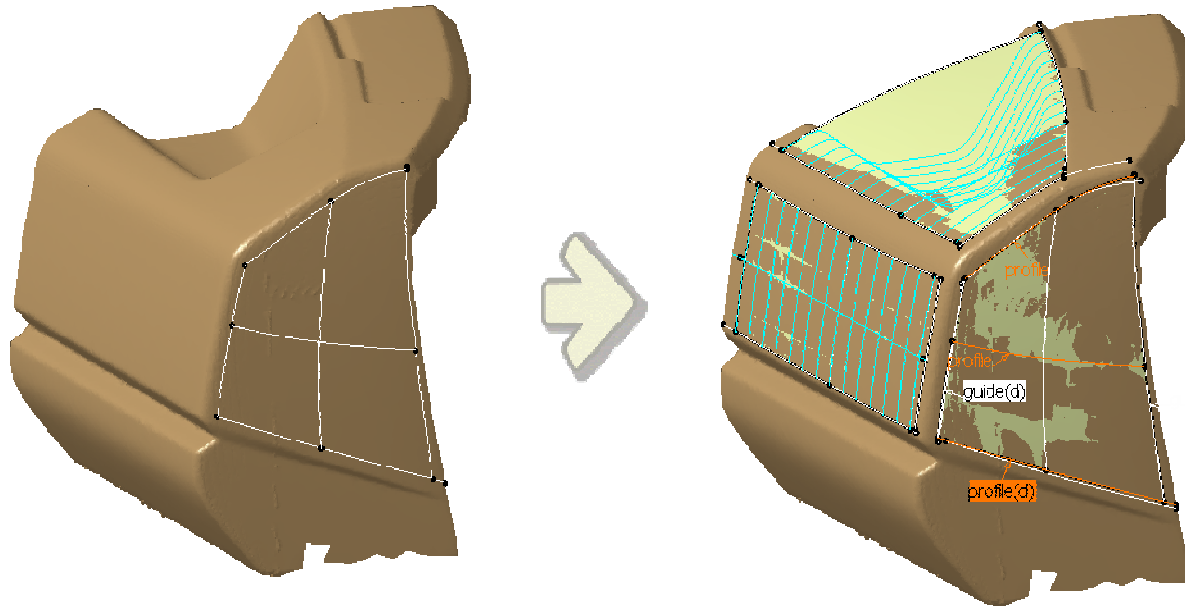
- Create the scans on the second main surface
 - ◆ Planar sections 
- Create the curves from the scans (ignore pocket area)
 - ◆ 3D curve 
- Check the distance between the curves and the scans
 - ◆ Distance analysis 

Do It Yourself (6/11)

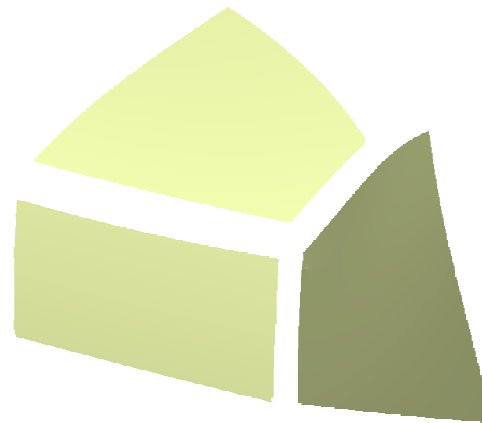


- Create the second main surface**
 - Net surface**
- Check the distance between the surface and the scans**
 - Distance analysis**
- Correct the curves or add more curves if the expected accuracy is not reached**

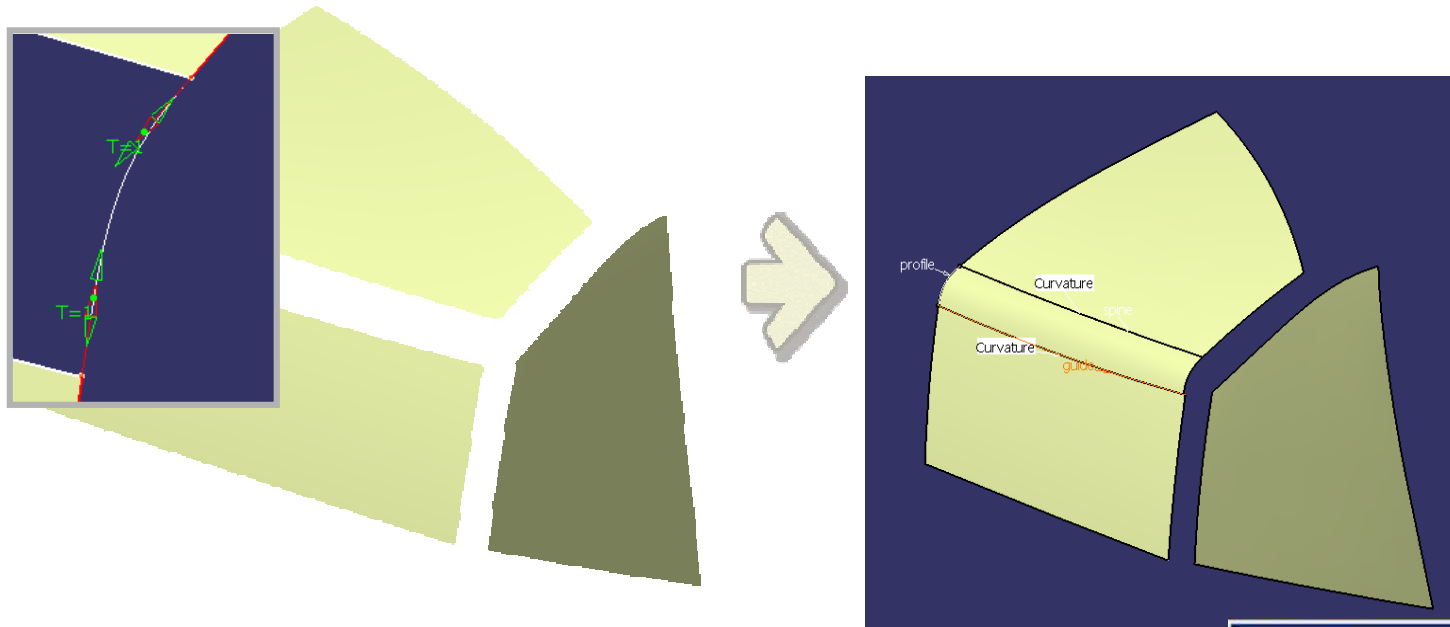
Do It Yourself (7/11)





- Create six curves for the last main surface
 - ◆ 3D curve 
- Create the last main surface
 - ◆ Net surface 



Do It Yourself (8/11)

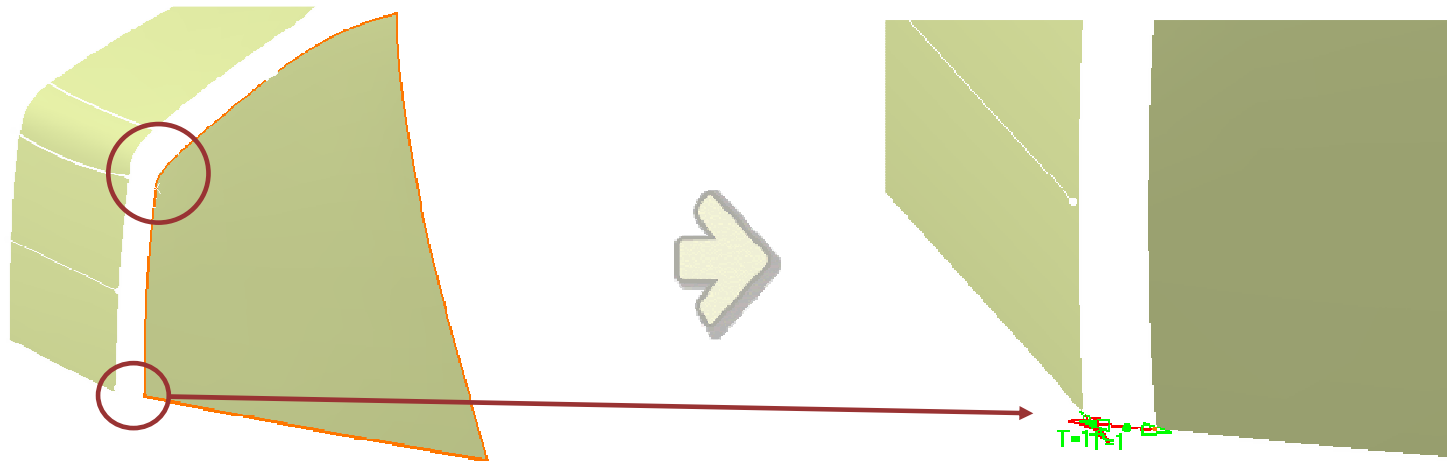


- Start a Generative Shape Design workbench
- Blend the two boundary curves with a curvature continuity
 - ◆ Connect curve 
- Create the first blend surface
 - ◆ FreeStyle Sweep 
 - ◆ Choose Sweep and Fit
 - ◆ Impose a curvature continuity with the main surfaces



 You can load: 04_Base_NetSurfaces.CATPart

Do It Yourself (9/11)



- Round the sharp corner of the third main surface

- Connect curve 

- Project curve 

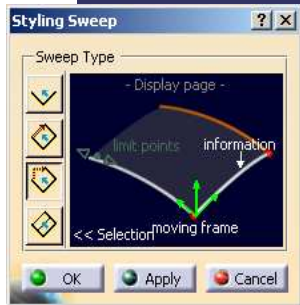
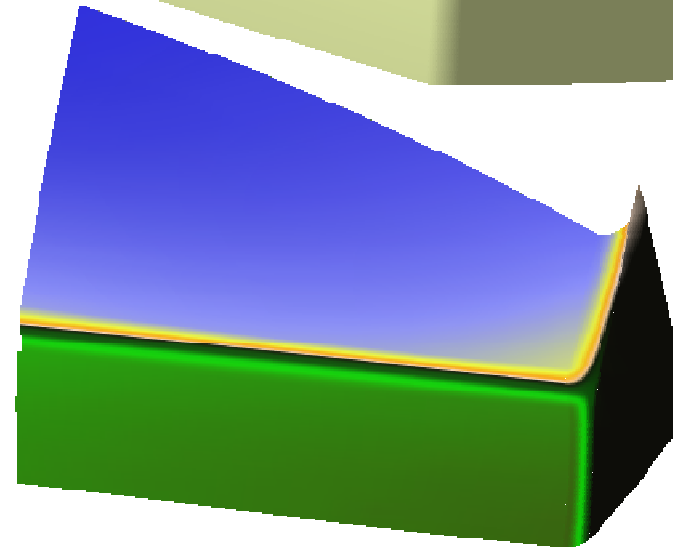
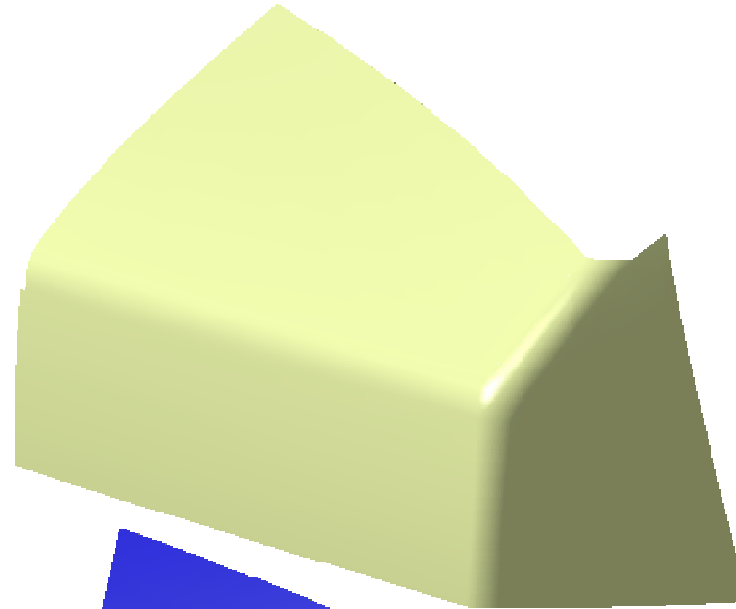
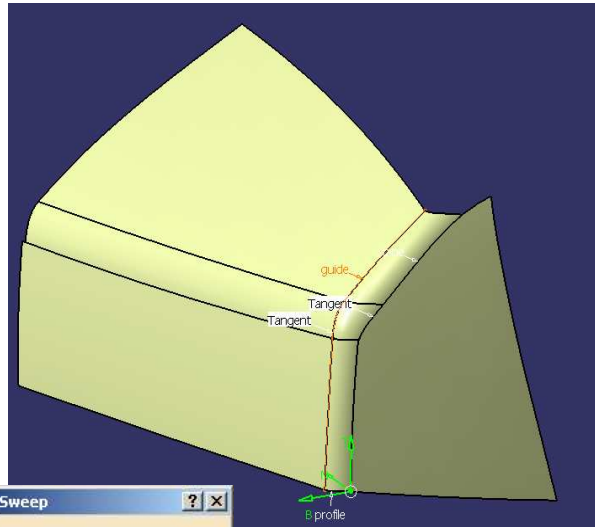
- Split 

- Create the profile for the last sweep

- Connect curve 

Student Notes:

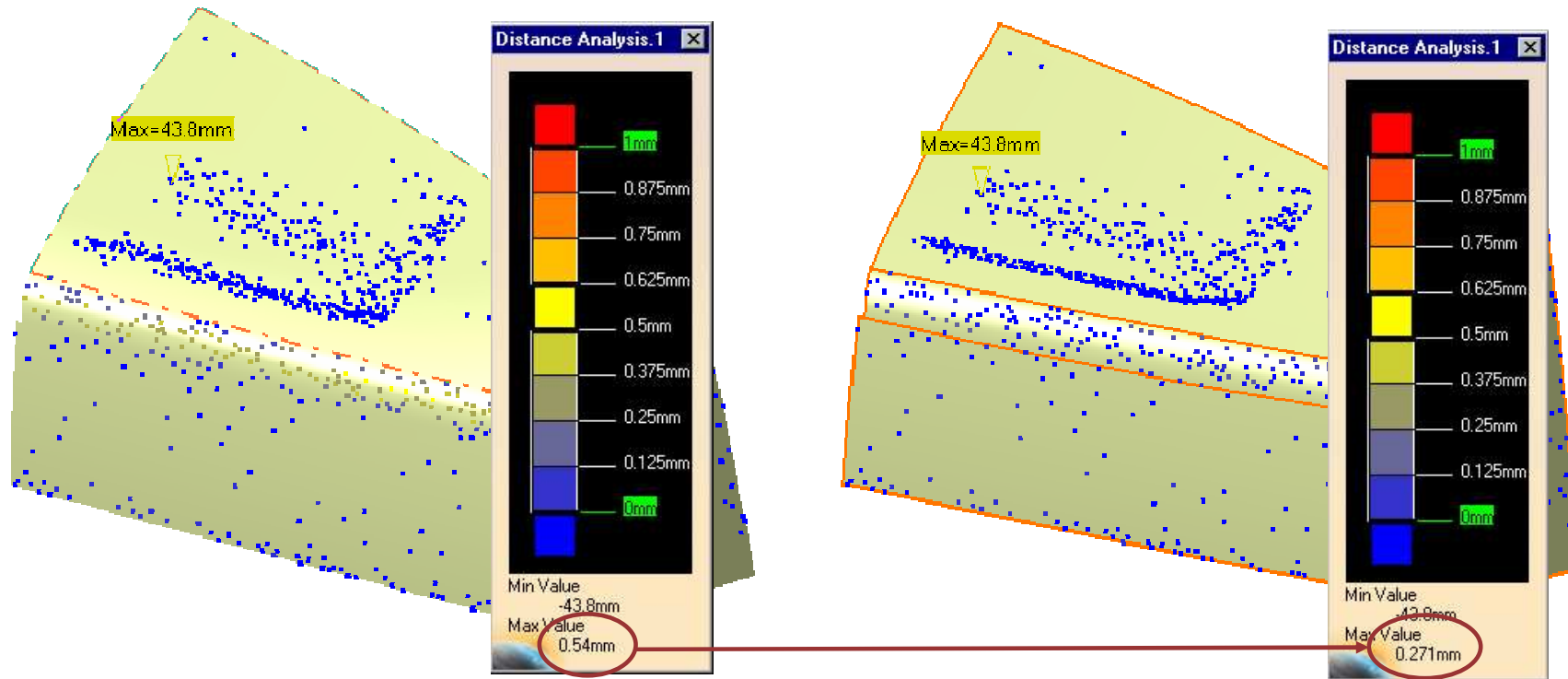
Do It Yourself (10/11)





- ❏ Create the last blend surface
 - ❖ FreeStyle Sweep 

Student Notes:

Do It Yourself (11/11)

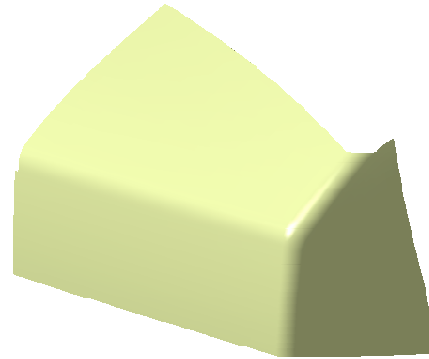


- Check the distance between the surface and some points of the cloud
 - ◆ Filter 
 - ◆ Distance analysis 
- ◆ Modify the input of the FreeStyle Sweeps if necessary to improve the accuracy

 You can load: 05_End_of_CurveBased.CATPart

QSR Network approach

Phase 4



In this exercise you will:

- See how to create surfaces from a cloud of points using Quick Surface Reconstruction (QSR).

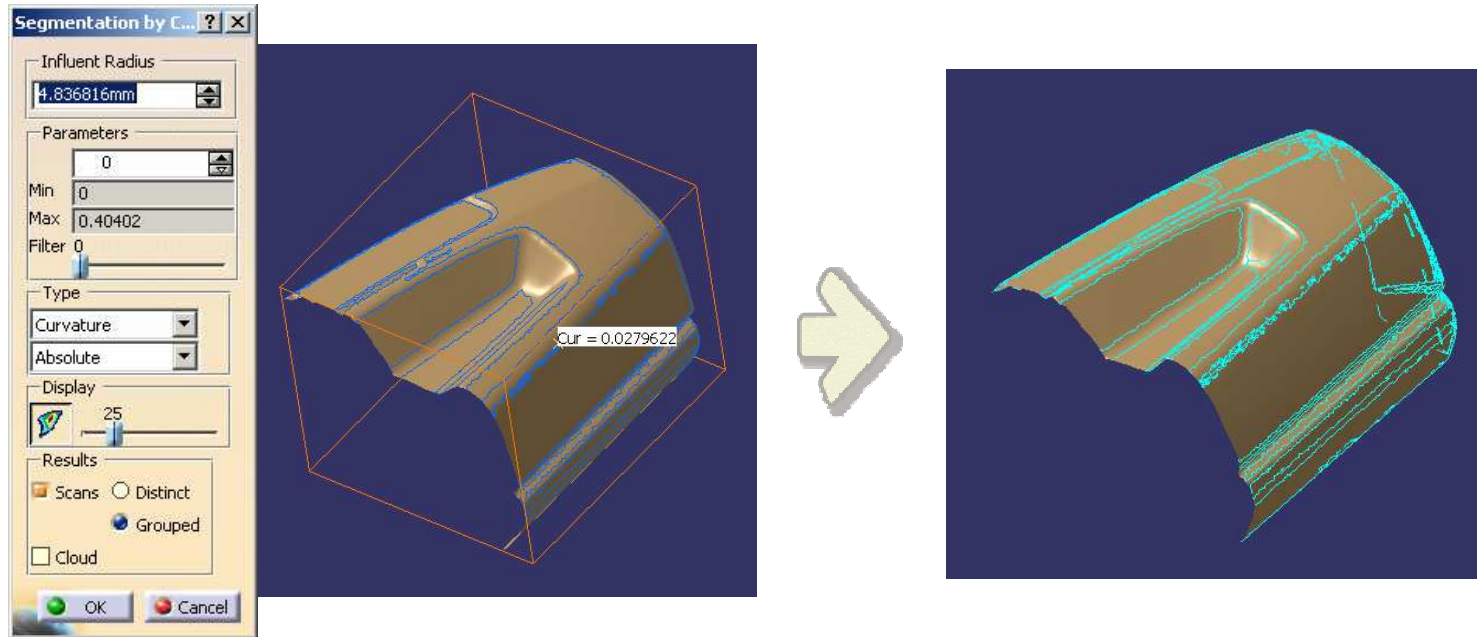
Characteristics of QSR:

- Creation of surfaces by Powerfit or canonic shape recognition
- Efficient for quality surface creation (if no strict accuracy expected)
- The quality of surfaces relies on the quality of input curves

Drawbacks:

- Not efficient for high quality design such as class A design

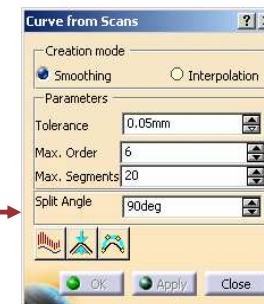
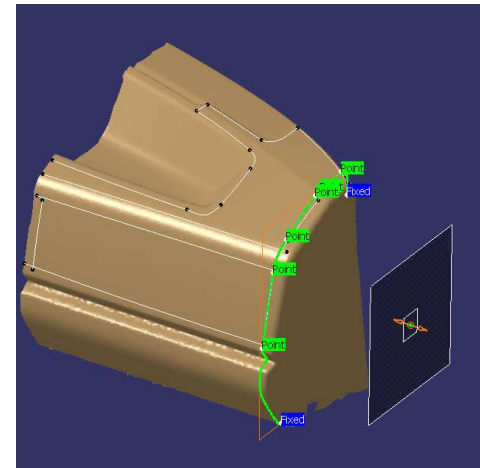
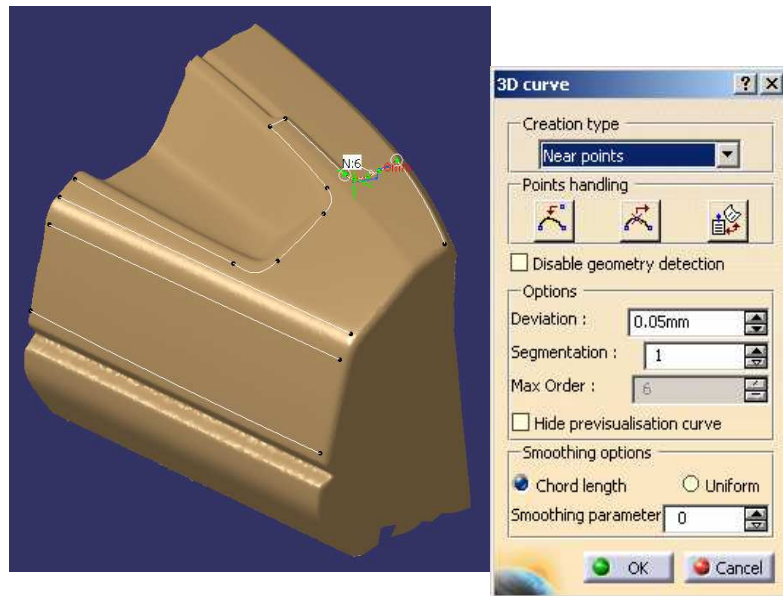
Do It Yourself (1/5)



 Load: 06_Begin_QSR.CATPart

-  Access the Quick Surface reconstruction workbench
-  Split the cloud according to its character lines
 -  Curvature analysis 

Do It Yourself (2/5)



Create surface boundaries

◆ 3D curve

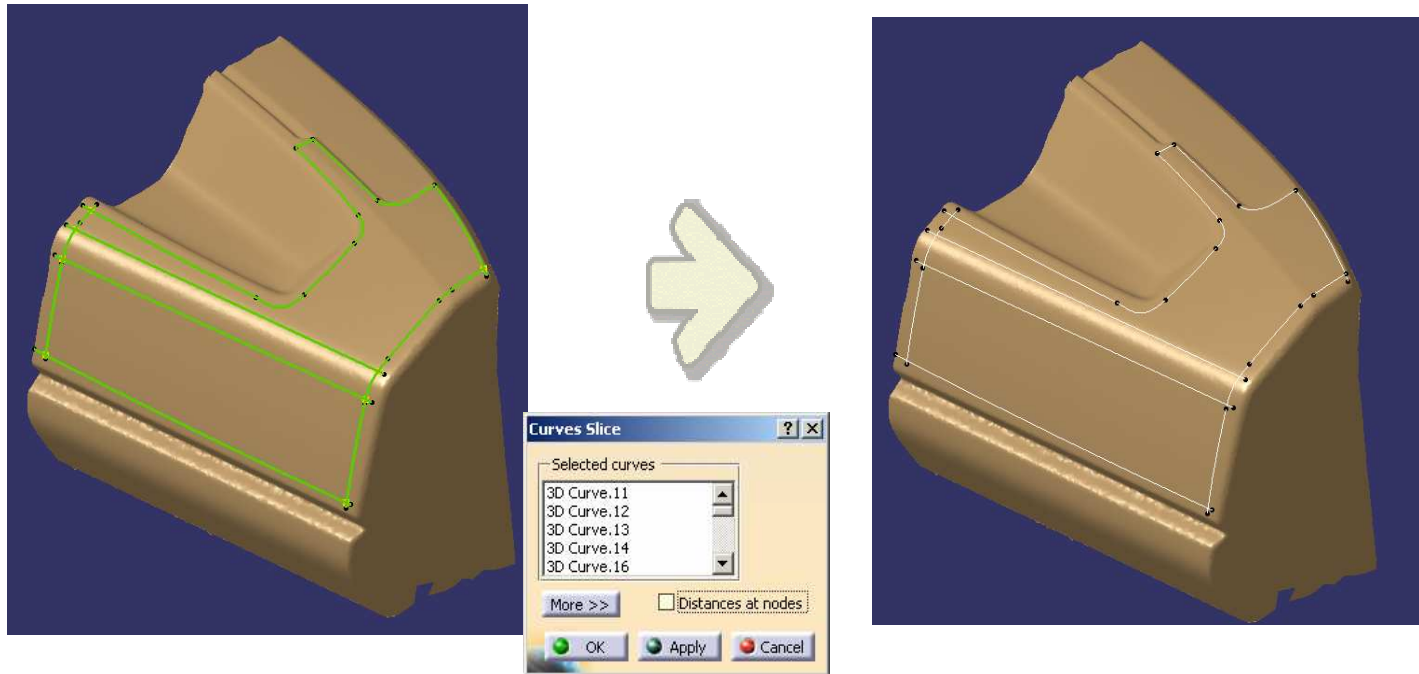
◆ Planar section

◆ Project curve

◆ Curve from scan

Student Notes:

Do It Yourself (3/5)

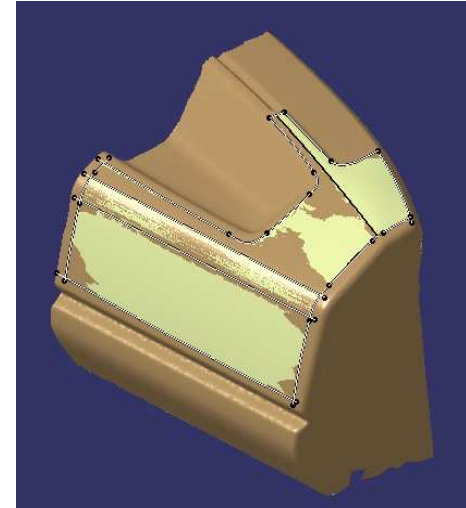
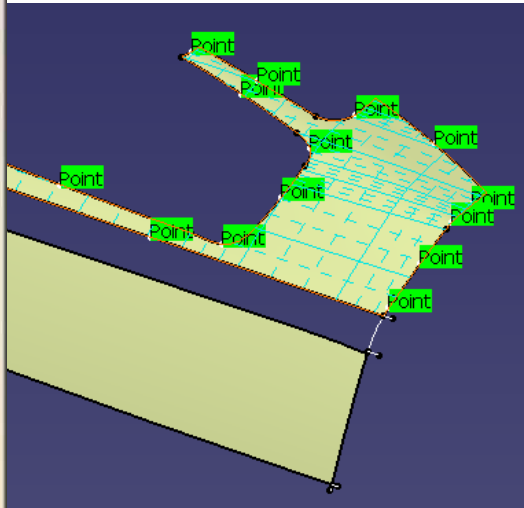
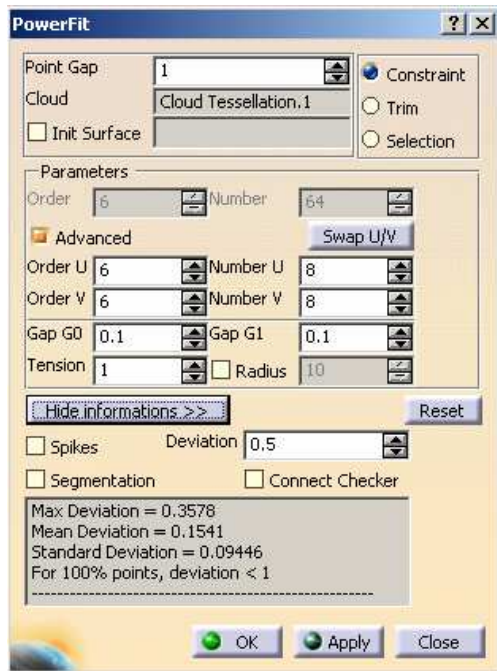


● Prepare curves for Powerfit

- ◆ Curve Slice 
- ◆ Clean contour 

Student Notes:

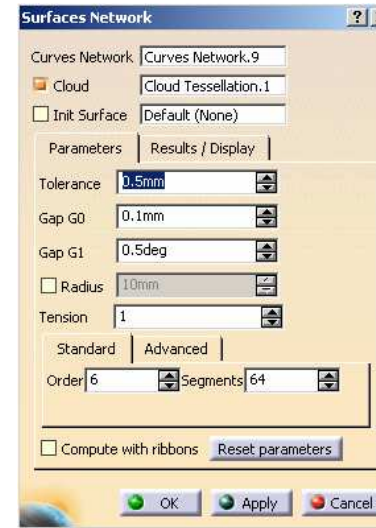
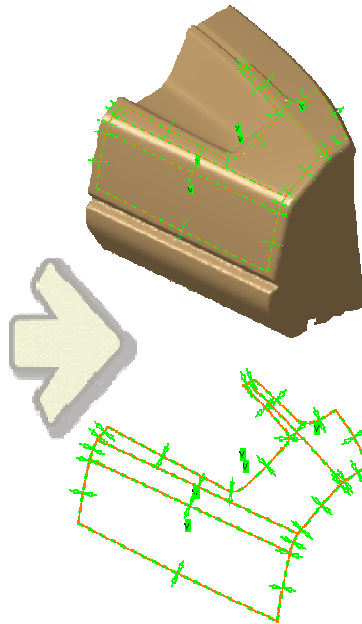
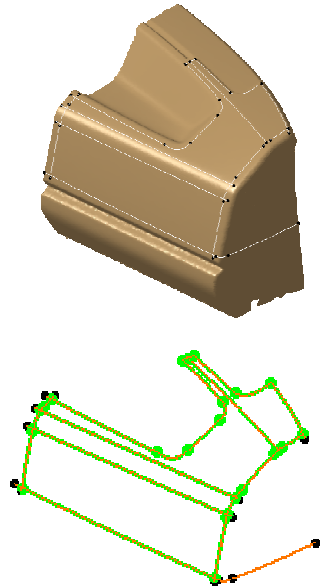
Do It Yourself (4/5)



- ◆ Create surfaces
- ◆ Powerfit 







Student Notes:

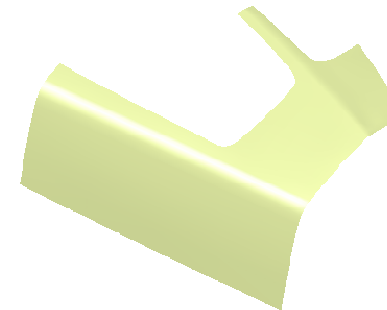
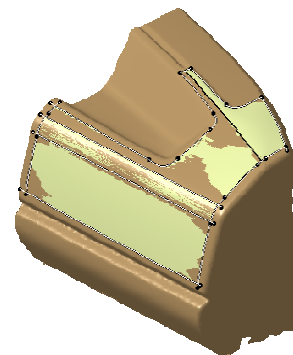
Do It Yourself (5/5)



 Load: 08_Begin_QSRNetwork.CATPart

OTHER POSSIBILITY with QSR:

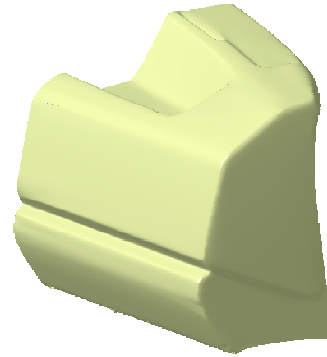
-  Create network
 -  Curves Network 
-  Create a surface
 -  Surfaces Network 



 You can load: 08_End_QSRNetwork.CATPart

QSR Automatic approach

Phase 5



In this exercise you will:

- See how to create surfaces from a cloud of points using The Automatic Surface command of QSR.

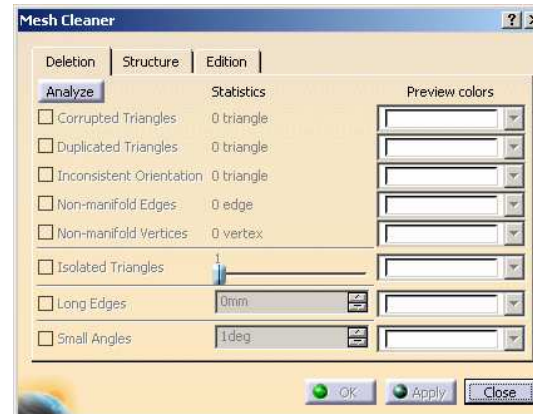
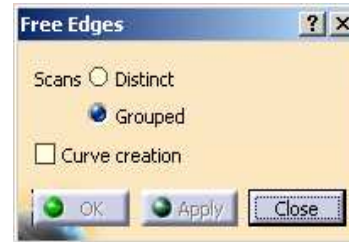
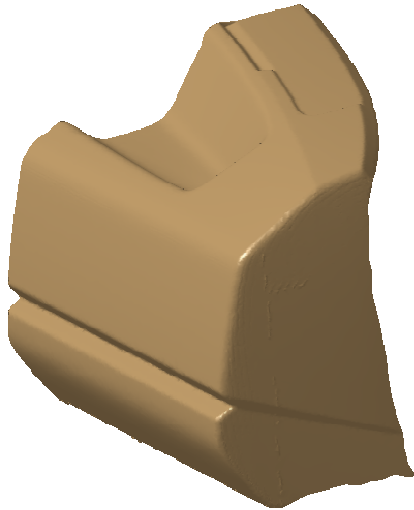
Characteristics of Automatic Surface:

- Very rapid surface creation
- Possibility to control accuracy
- Easy to use because of few parameters to control
- Very efficient for rough surface creation or to quickly replace a cloud by a smooth surface

Drawbacks:

- Mesh needs to be manifold and seamless
- No control on the face structure of the resulting surface

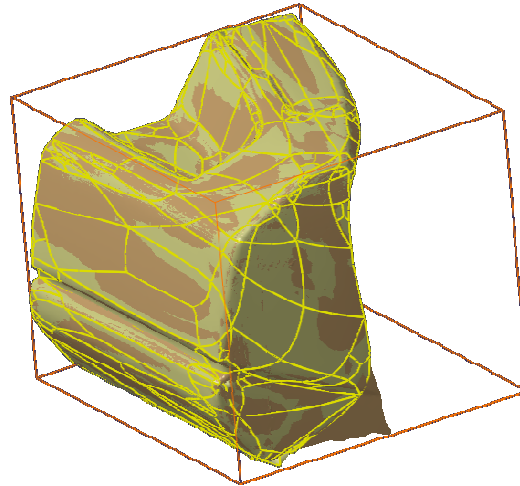
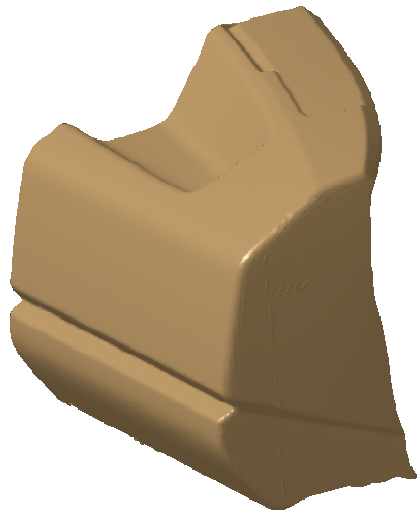
Do It Yourself (1/4)




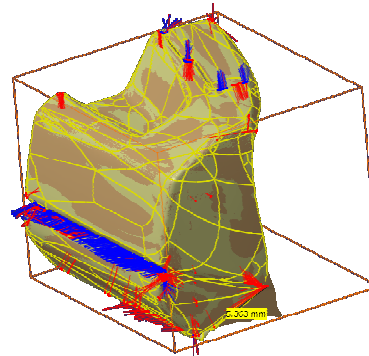
 Load: 090_QSRAutomaticSurface.CATPart

-  Check that the cloud is valid for Automatic Surface
 -  Create free edges 
 -  Mesh Cleaner 
-  Repair mesh defects if any

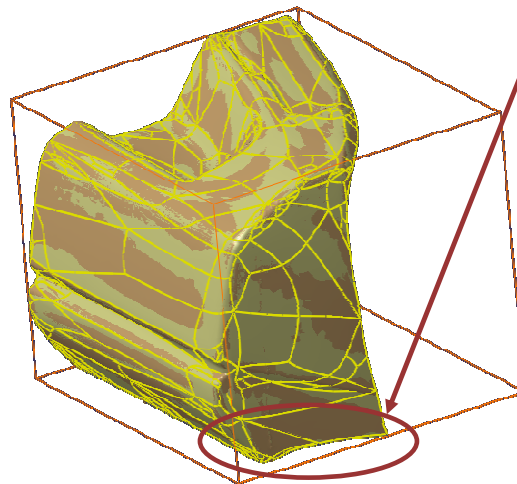
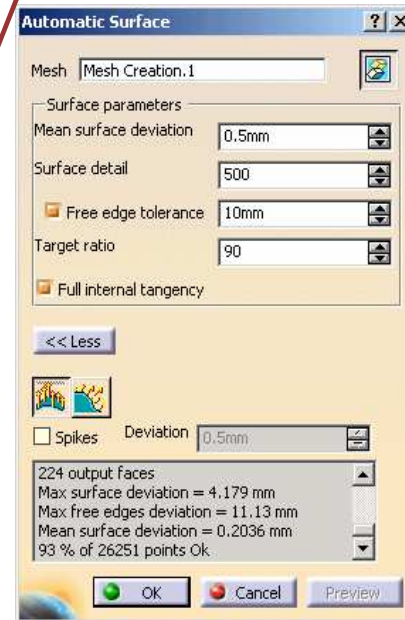
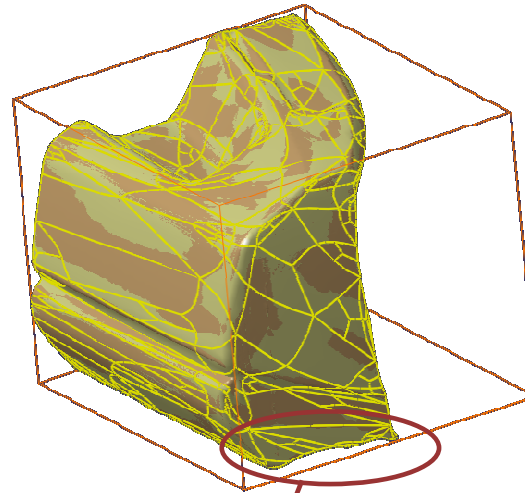
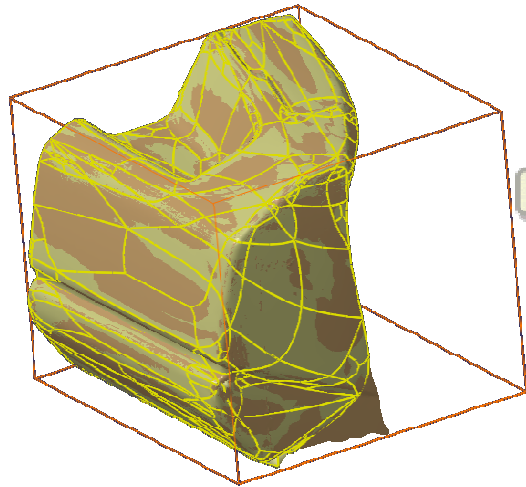
Do It Yourself (2/4)



- Create a rough surface
 - ◆ Automatic Surface 
 - ◆ Analyze surface accuracy and quality



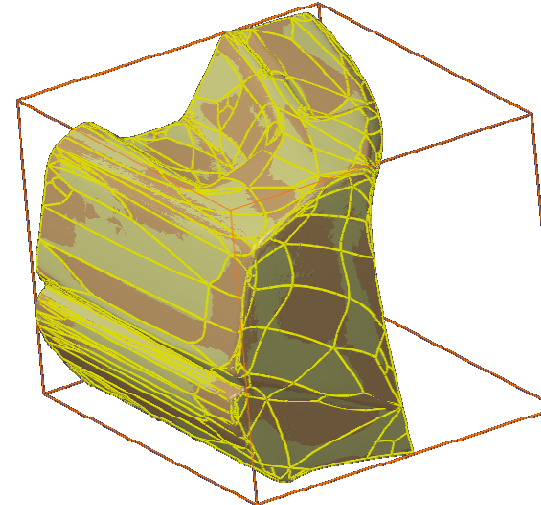
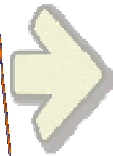
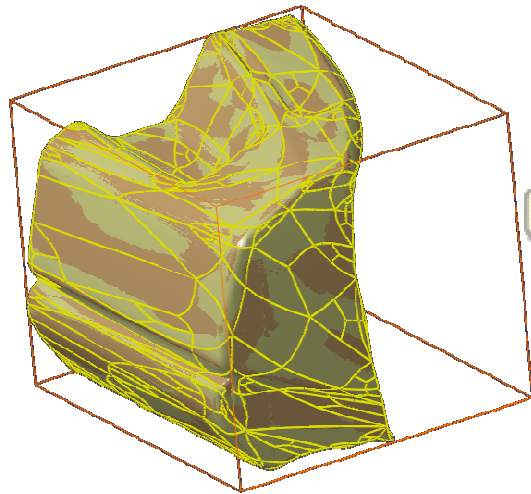
Do It Yourself (3/4)




- **Improve surface edge**
 - ◆ **Automatic Surface**
 - ◆ **Check result**

Student Notes:

Do It Yourself (4/4)



- **Improve surface accuracy**
- ◆ **Automatic Surface** 
- ◆ **Check result**

