



# CATIA V5 Training

## Foils

# Realistic Shape Optimizer

Version 5 Release 19  
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EDU\_CAT\_EN\_RSO\_FF\_V5R19

# About this course

## Objectives of the course

Upon completion of this course you will be able to:

- Deform a surface using the Displacement file resulting from Finite Element Analysis

## Targeted audience

Surface designers, Tooling designers

## Prerequisites

Students attending this course should be familiar with the basics of wireframe and surfaces creation

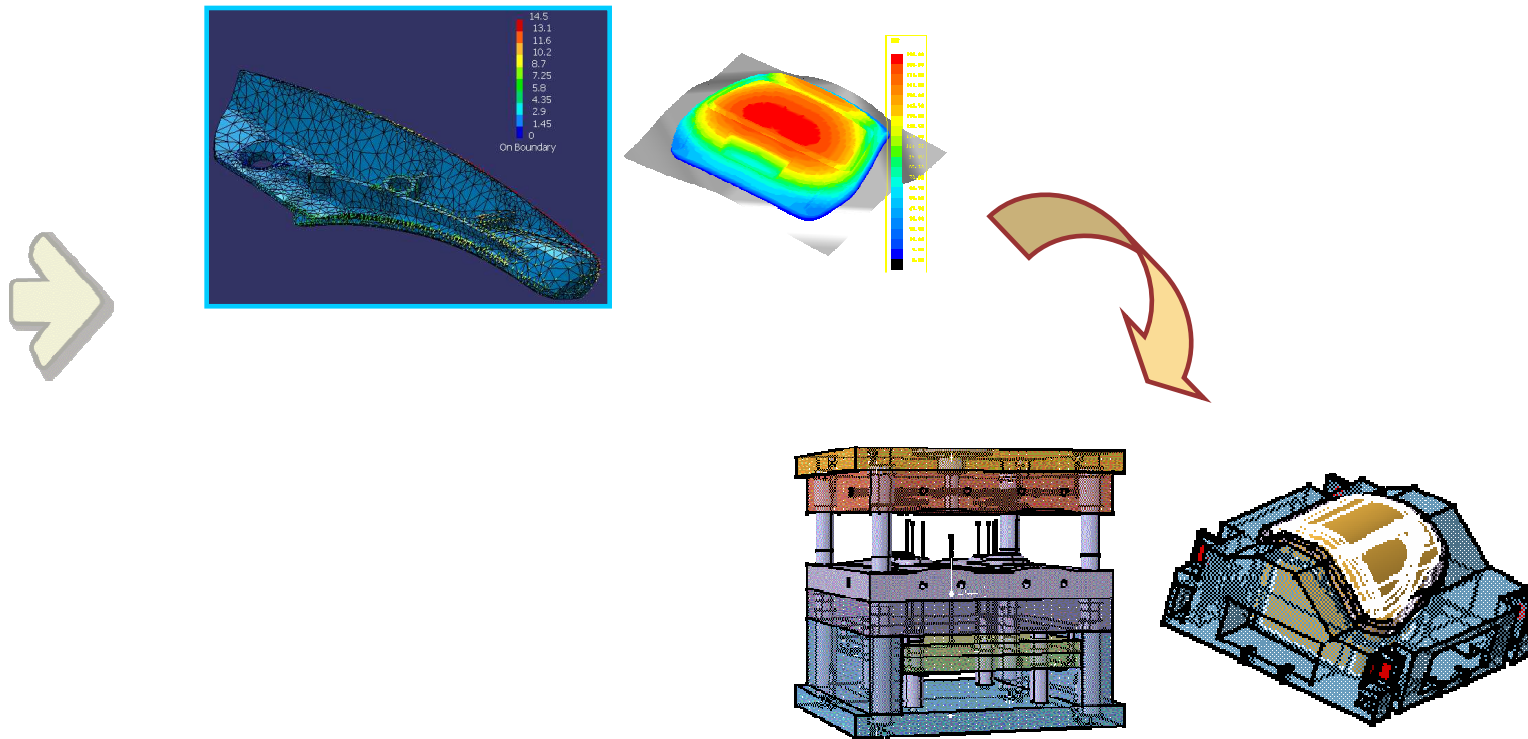


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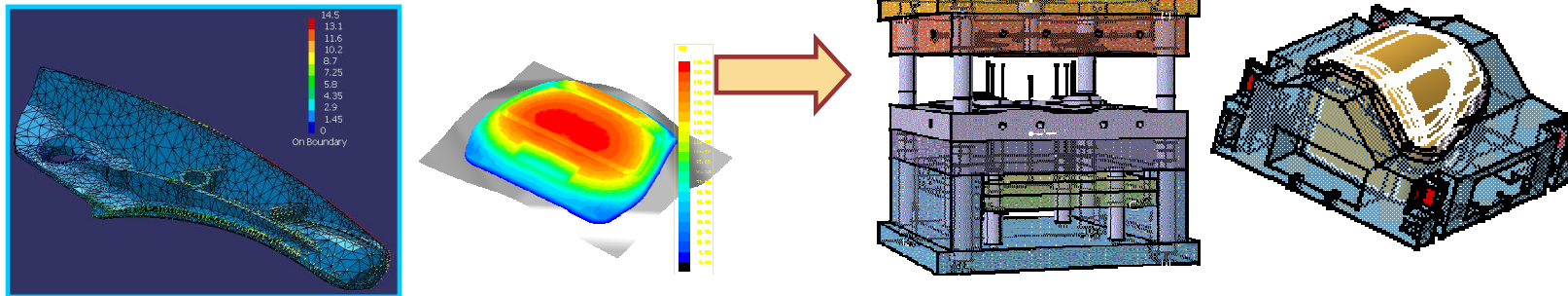
# Introduction to Realistic Shape Optimizer

*In this lesson, you will become familiar with RSO basics.*



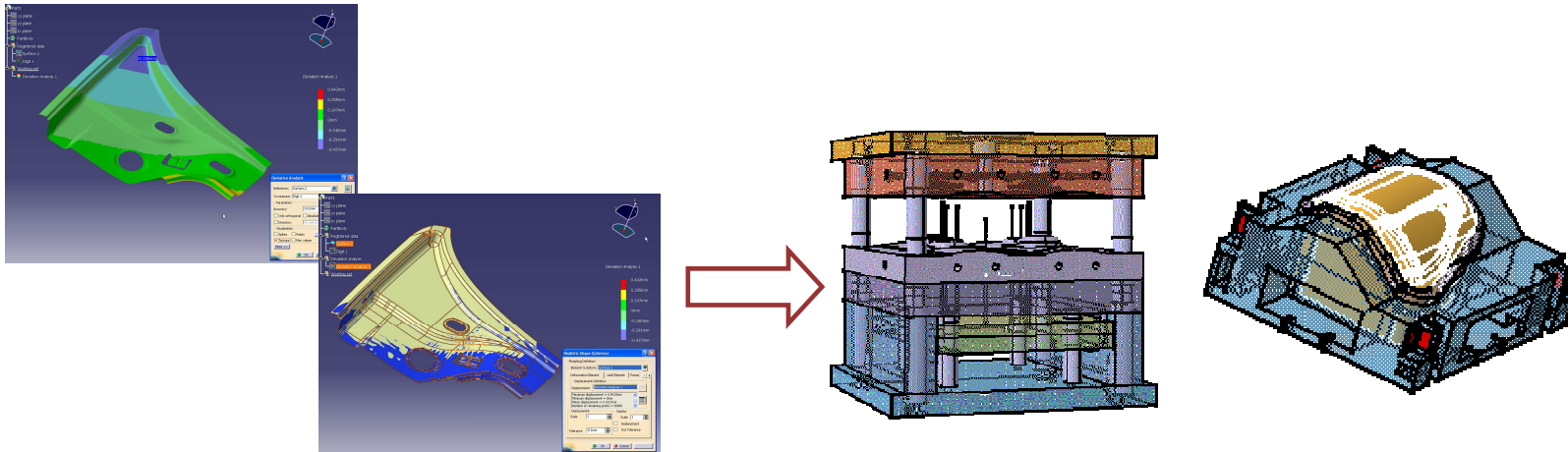
## Why Do You Need RSO? (1/2)

- **Context 1: Use results of a finite element analysis (FEA)**
  - ◆ A design part has been analyzed by a finite element method.
  - ◆ The finite element method outputs a description of the part deformation.
  - ◆ The deformation has to be applied to the CAD part to get the corresponding deformed CAD part.
  
- **Examples:**
  - ◆ Injection simulation for the computation of shrinkage: the shrinkage is evaluated by finite element methods and has to be compensated when designing the mold.
  - ◆ Computation of spring-back: spring-back can be evaluated by a finite element simulation and needs to be compensated at the die face design level.
  - ◆ Propellers or turbine blades are designed in use (movement, temperature...) by specialized software, their shape when still at ambient temperature has to be found at production stage.



## Why Do You Need RSO? (2/2)

- **Context 2: Use results of a deviation analysis**
  - ◆ A reference part is available in CATIA
  - ◆ A prototype or sample has been manufactured
  - ◆ The manufactured part is compared to the reference part by Deviation Analysis
    - Requires the use of CATIA Quick Surface Reconstruction workbench (QSR)
  - ◆ A CAD model of the real part is required
  
- **Examples:**
  - ◆ Integration of real part in digital mock-up for further analysis
  - ◆ Tuning of tooling (specially stamping dies)

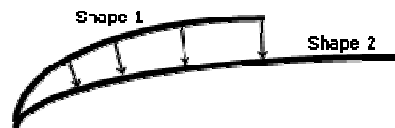
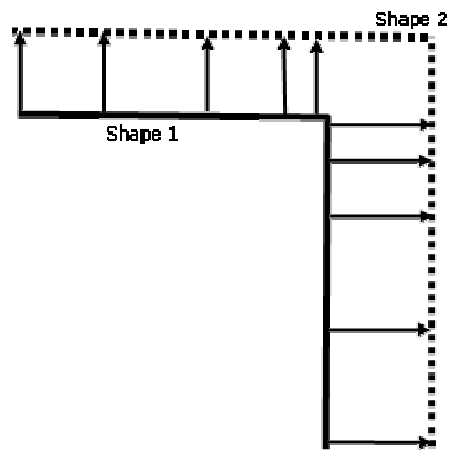


## WARNING

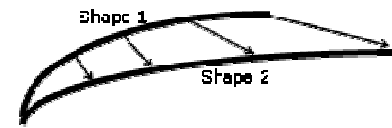
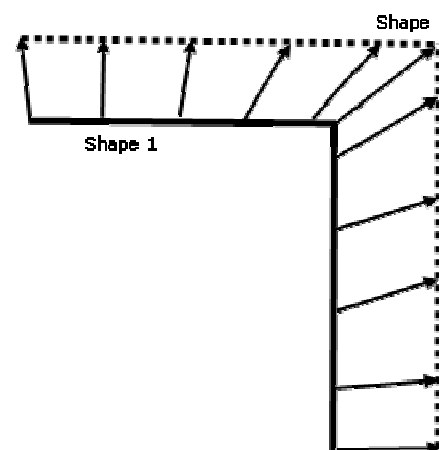
A Deviation Analysis is not an exact representation of a deformation !

The displacements created by a Deviation Analysis between two shapes are different from the displacements to apply to transform a shape into the other one, especially when the initial shape presents sharp edges or curvature variations or when the deformation includes a "stretching" of the initial shape.

Deviation Analysis:

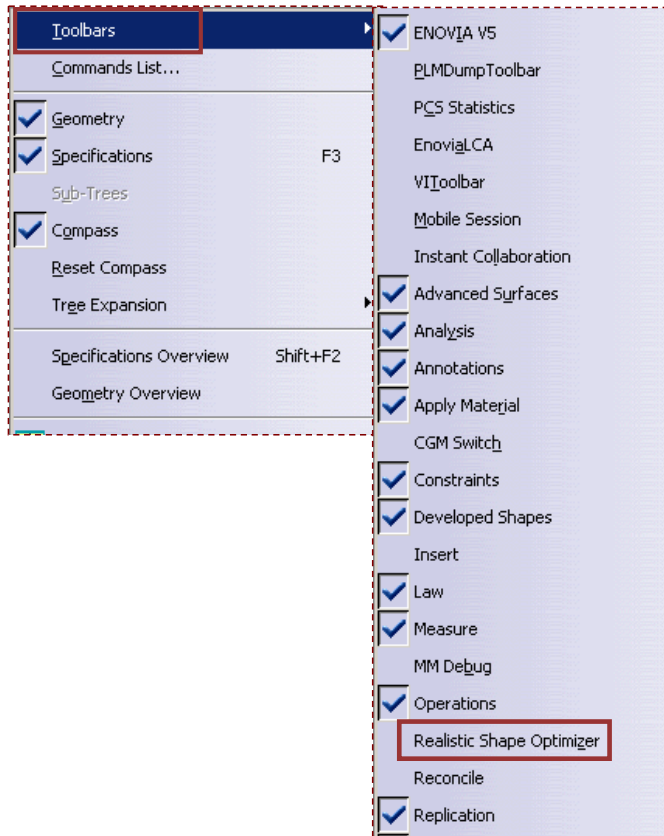


Required displacements:



# Accessing the Workbench

- RSO is accessible from Core and Cavity Design or Generative Shape Design workbenches
- This tool bar is active by default in CCV workbench
- In GSD it has to be activated via View > Toolbars



**RSO tool bar:**

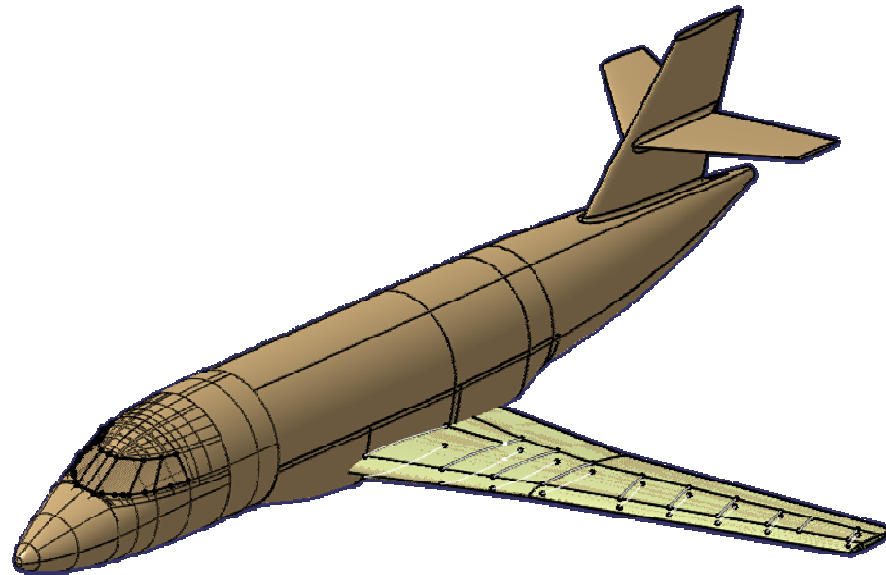
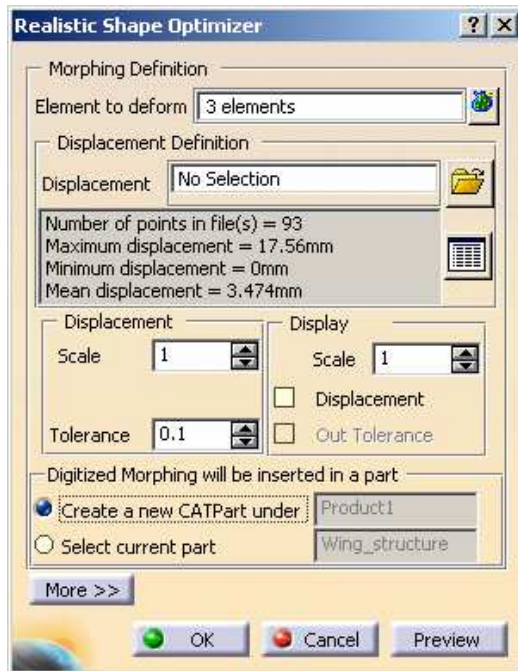
← **Digitized Morphing**

← **Update Digitized Morphing**



# Surface Deformation

*In this lesson you will learn about Deforming a Surface with a Displacement File and Update a Deformation Feature.*




## Digitized Morphing: Inputs



The Input Data for Digitized Morphing is:

- Surface(s) (multi-selection available)  
the surface(s) can be any CATIA V5 or imported surface. They can be associative or not.

### Warning:

- Today the command does not support multi-output bodies, it outputs one feature for each selected surface.
  - In case of multi-selection the deformation field is re-computed for each feature. To avoid excessive computation time you can activate Datum Mode. 
  - It is better to join surfaces before performing the deformation to preserve the connections between the input surfaces. (the topology is strictly preserved)
- Some computation and display parameters.
  - One or several displacement files.

## Displacement Files (1/2)

A Displacement File is a simple text file with 6 columns of real values.

- Real values represent Point Coordinates and corresponding Displacement along the main axes.
- The first line with text (title, column headers, ...) will be skipped

X	Y	Z	DX	DY	DZ
7.9621768		24.523676		-9.175852	
				-0.374125004	0.228395462
7.9621768		25.476324		-9.175852	
				-0.366230488	0.235614777
7.9621768		51.523674		-9.175852	
				-0.272540569	0.38237381
7.9621768		52.476326		-9.175852	
				-0.269556522	0.397731781
12.8375463		24.508671		-8.316193	
				-0.328528404	0.201967239
12.8375463		25.491329		-8.316193	
				-0.324790955	0.208269119
12.8375463		52.491333		-8.316193	
				-0.235010147	0.39352417
13.2604218		51.507366		-8.241629	
				-0.231938362	0.377723694
17.7129154		24.493666		-7.456533	
				-0.275337219	0.173631668
17.7129154		25.506334		-7.456533	
				-0.268447876	0.179769516
17.7129154		52.506336		-7.456533	
				-0.197212219	0.376548767
18.5586681		51.491062		-7.307905	
				-0.186105728	0.361289978
					-0.195227623

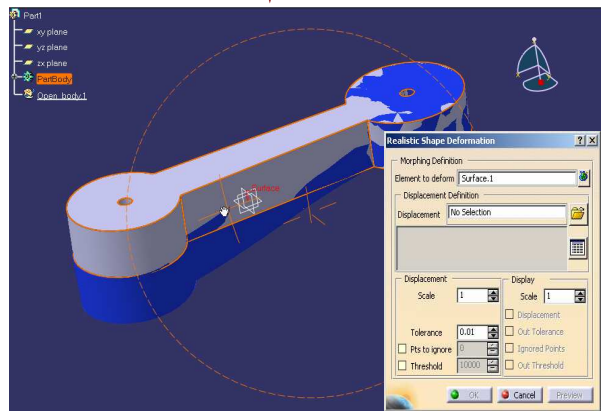
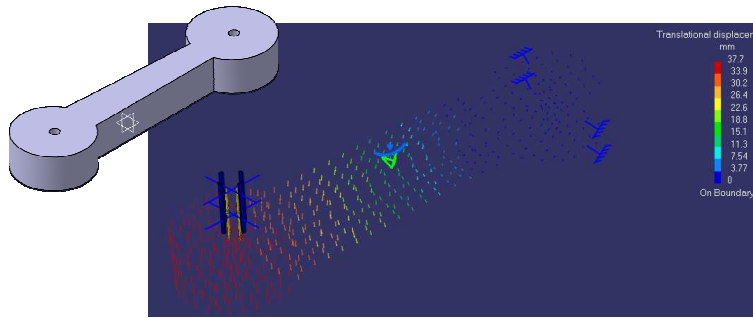
Point Coordinates

Displacements

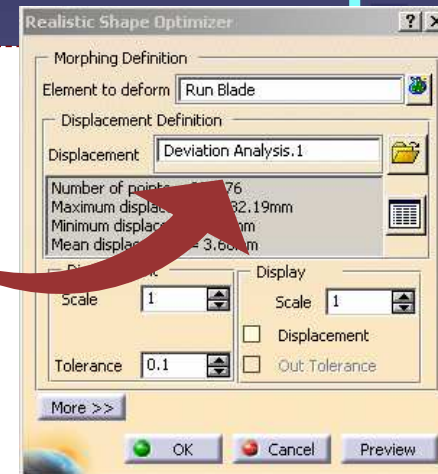
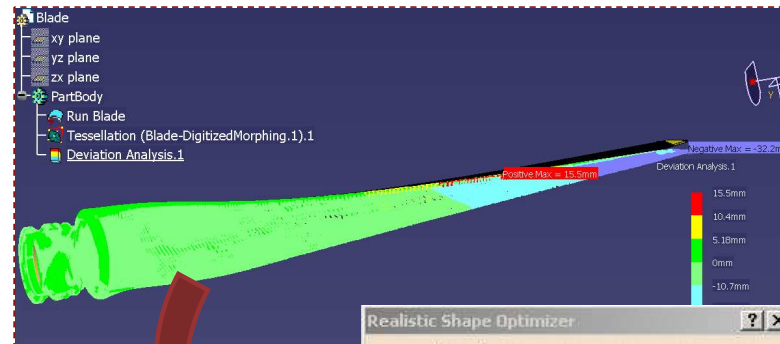
## Displacement Files (2/2)

A Displacement File may be:

- A result of a CATIA Analysis & Simulation computation (CAT Analysis)



- A result of deviation analysis in Quick Surface Reconstruction Workbench (QSR).



# User Interface (1/4)



## First tab: Deformation Element

Access to list of selected displacement file(s)

**Surface(s) to deform** →

**Displacement file(s)** →

**Statistics on the selected displacement file(s)** →

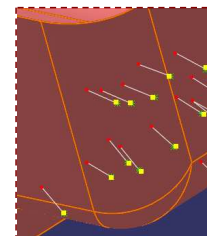
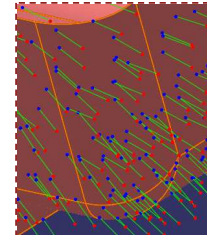
**Displacement Parameters:**  
**Scale:** Ratio to be applied to displacements  
**Tolerance:** Accuracy of surface approximation

**Display Parameters** →

Name	In Folder	Nb points
Exercise_Displacements.txt	I:\ILTR15\RSD\Data\	826
Exercise_Displacements-split2.txt	I:\ILTR15\RSD\Data\	357

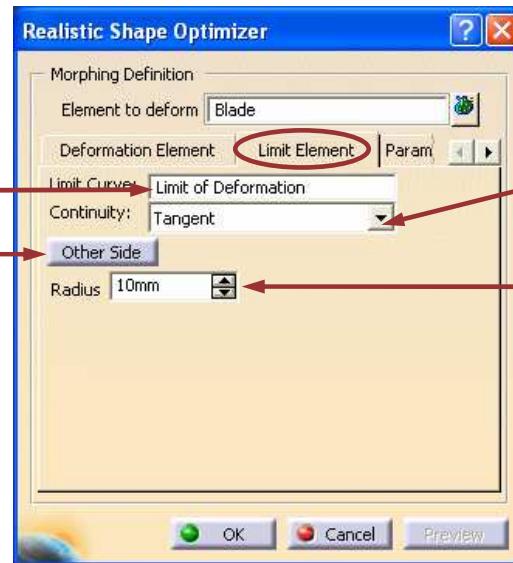
**Displacement:** show displacements as points and lines, the length of the lines is given by the Scale factor.

**Out Tolerance:** once a deformation computation has been done you can highlight points where accuracy has not been reached.



# User Interface (2/4)

## Second tab: Limit Element



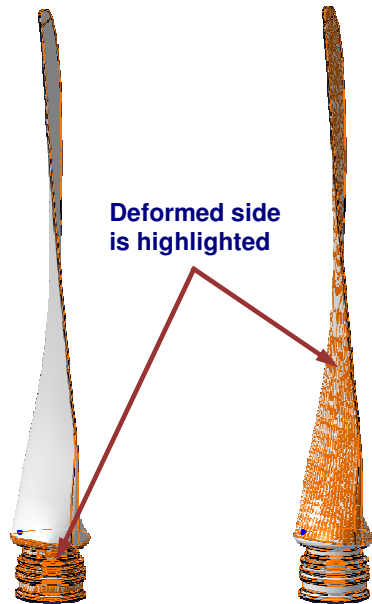
Limit curve (only one)

Selection of side to keep and side to deform

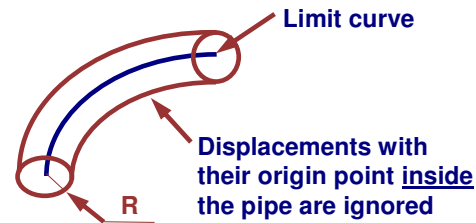
Continuity to preserve along the limit line between deformed and non-deformed areas.



Choice of radius for the elimination of displacements near the limit line to avoid conflicts: all points located inside pipe with given radius are ignored.



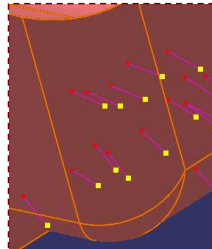
Deformed side is highlighted



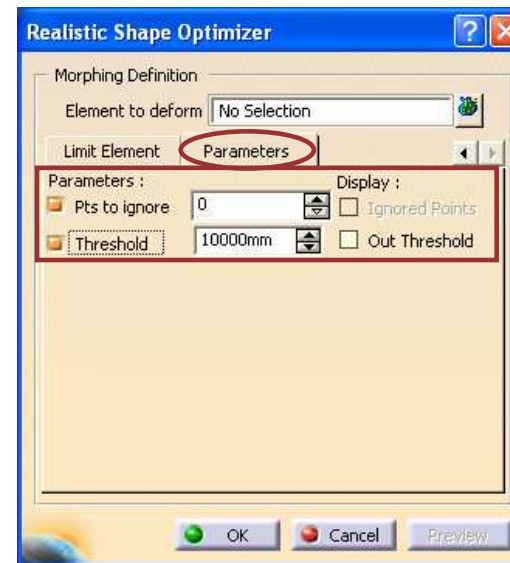
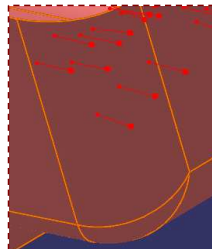
## User Interface (3/4)

### Third tab: Parameters

**Pts to ignore = Ratio (%) of points that can be ignored to improve the quality of the result = after a deformation computation, the displacements where the accuracy is the lowest are removed and a second computation is performed (= erroneous or unreliable points are filtered out); you can highlight ignored points for checking.**



**Threshold: Maximum value for displacement length, greater displacements are ignored; you can highlight points out of threshold for checking.**



## User Interface (4/4)


When working in product mode you can also choose if the deformed surface should be created in the current part or in a new part.

The image shows a CAD software interface with a 3D model of an aircraft wing. On the left is a tree view of the design structure. At the bottom of the tree, 'RSO Morphing Part (RSO Morphing Part.1)' is highlighted with a white box. On the right, the 'Realistic Shape Optimizer' dialog box is open. It contains several sections: 'Morphing Definition' with 'Element to deform' set to '3 elements'; 'Displacement Definition' with 'Displacement' set to 'No Selection' and statistics for points, maximum, minimum, and mean displacement; 'Displacement' and 'Display' sections with 'Scale' set to '1' and checkboxes for 'Displacement' and 'Out Tolerance'; and a section titled 'Digitized Morphing will be inserted in a part' which is highlighted with a red box. In this section, the radio button for 'Create a new CATPart under' is selected, and the dropdown menu shows 'Product1'. The 'Select current part' option is unselected, and its dropdown shows 'Wing\_structure'. At the bottom of the dialog are 'More >>', 'OK', 'Cancel', and 'Preview' buttons.



## Update Digitized Morphing



- The Update command can be used to update the Digitized Morphing features after a change in the displacement file(s)
  - In the case of features created from a Deviation Analysis or from translational displacement vectors stored in a CATAnalysis the update can be done with the standard update mechanism of CATIA (automatic or manual update with ).
- When you select the command, all Digitized Morphing features in the current part are analyzed to check if the displacement file(s) have changed since the feature creation.
- A displacement file is said to have changed if its creation date is changed (the feature includes a time stamp)
- If no displacement file has been modified you get a message



- Otherwise the list of features with modified displacement files is shown and you can select the features to update:



## To Sum Up

In this course you have seen:

- How to deform a surface or a set of surfaces using a displacement file, a deviation analysis or an analysis result
- How to update Digitized Morphing features