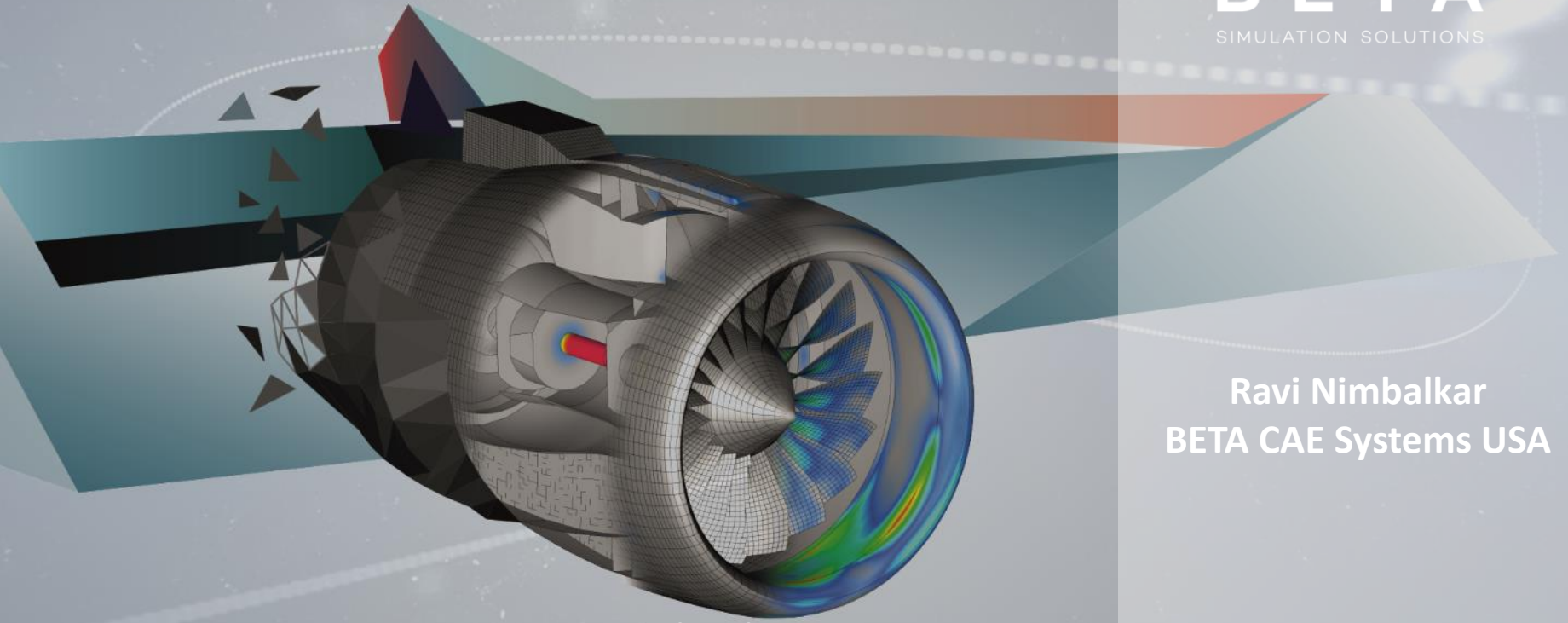
Morphing and Optimization with ANSA and META for Aerospace Applications

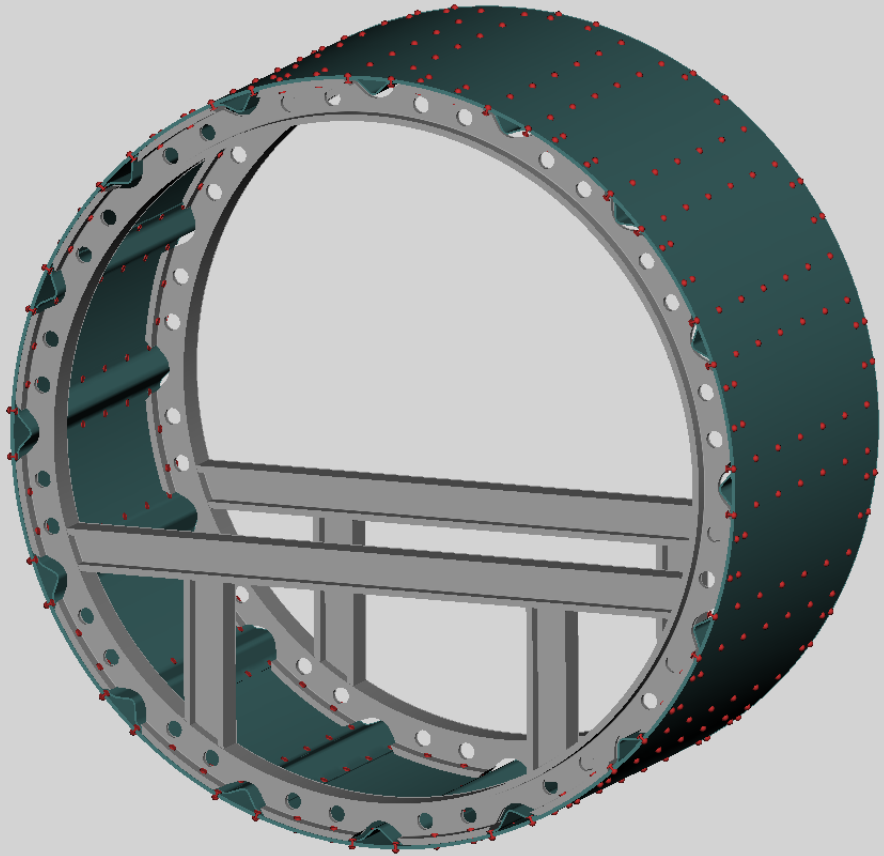
BETA
SIMULATION SOLUTIONS



Ravi Nimbalkar
BETA CAE Systems USA

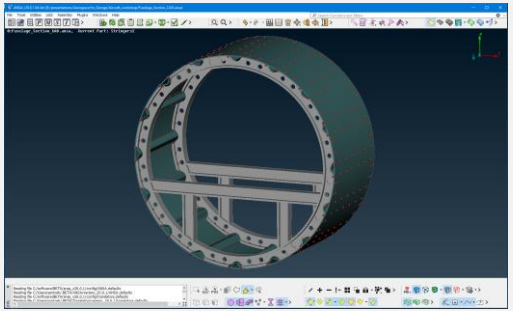
NASA - Advanced Modeling & Simulation (AMS) Seminar Series
SEPTEMBER 2, 2021

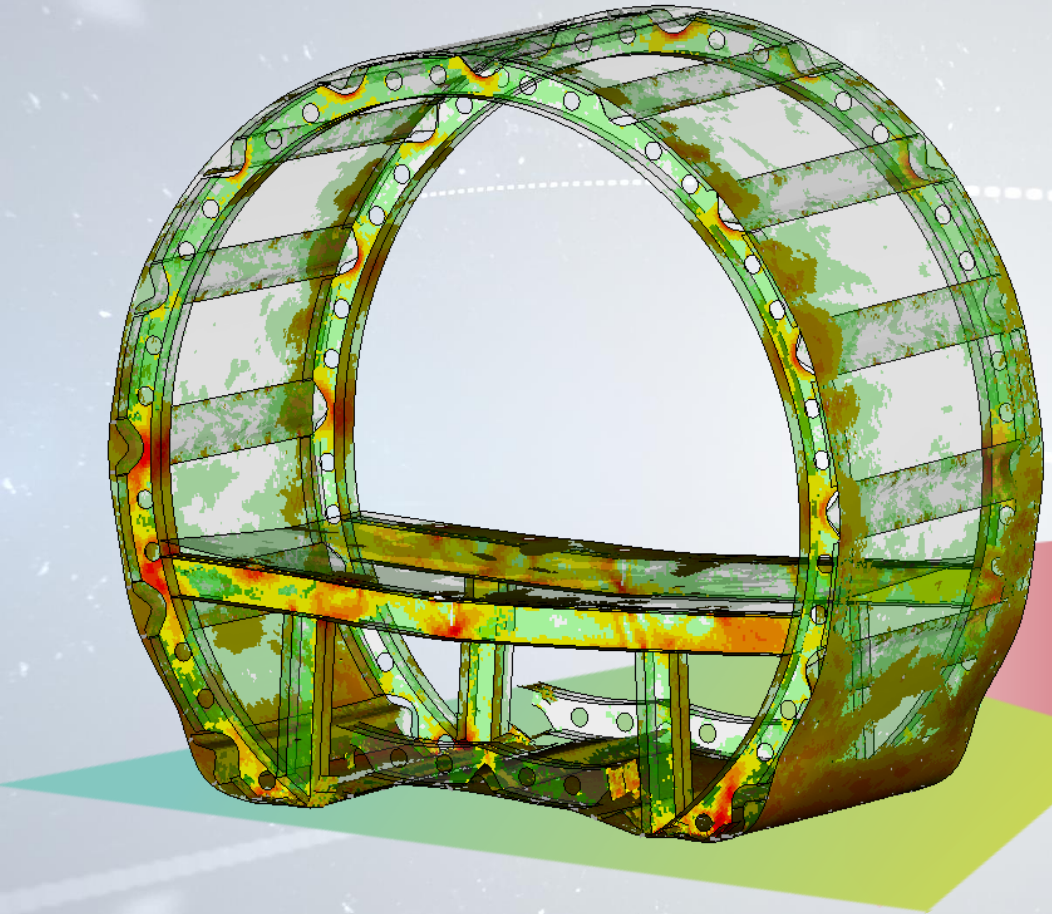
physics on screen



ANSA
PRE PROCESSOR

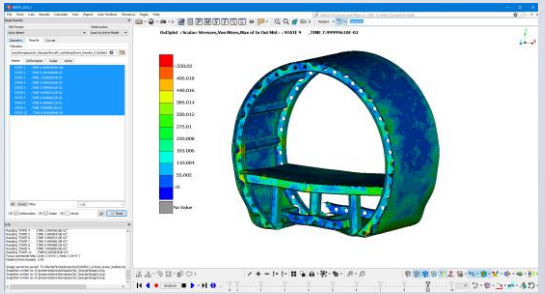
The most complete solution for full multivariant model build up. Quality, automation, performance, multidisciplinary nature and abundance in features and tools, in a single environment.





META
POST PROCESSOR

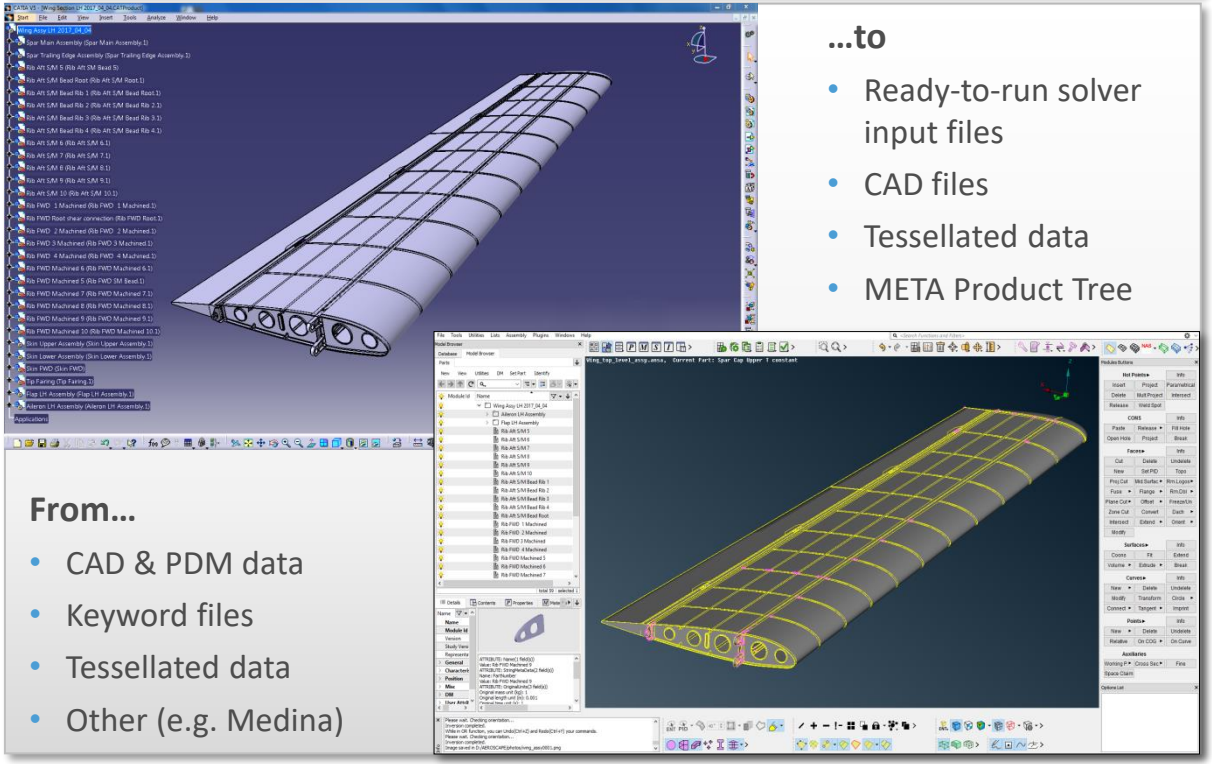
The powerful platform for effectively handling the most demanding post-processing tasks, including animations, plots, videos, virtual reality and reporting.



physics on screen

Interfaces

ANSA input / output



From…

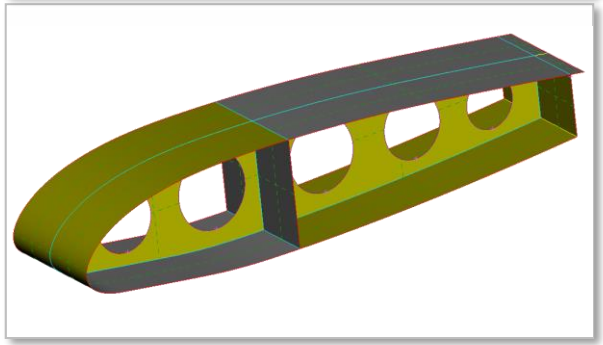
- CAD & PDM data
- Keyword files
- Tessellated data
- Other (e.g. Medina)

…to

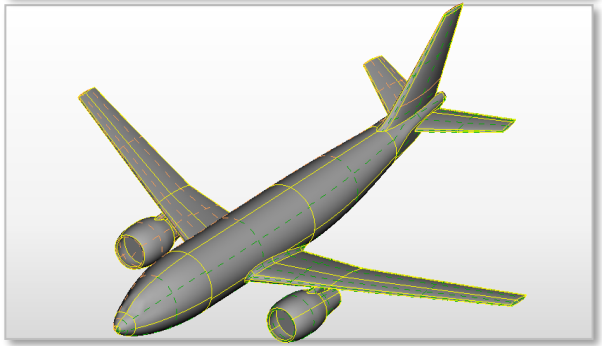
- Ready-to-run solver input files
- CAD files
- Tessellated data
- META Product Tree

Geometry

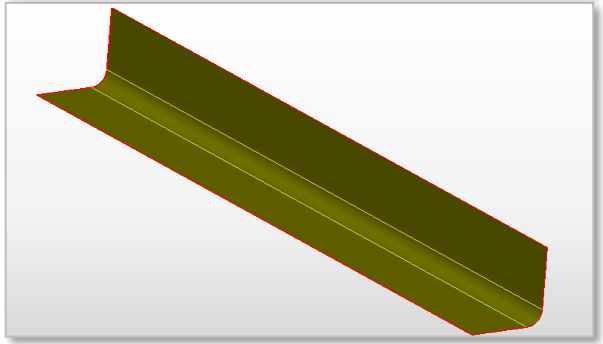
Geometry Creation



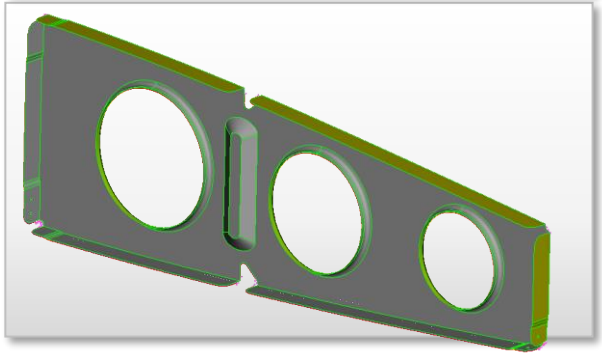
Handling Symmetry



Holes treatment

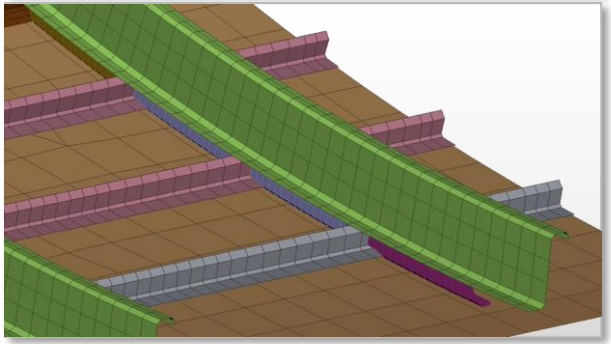


Fillets handling

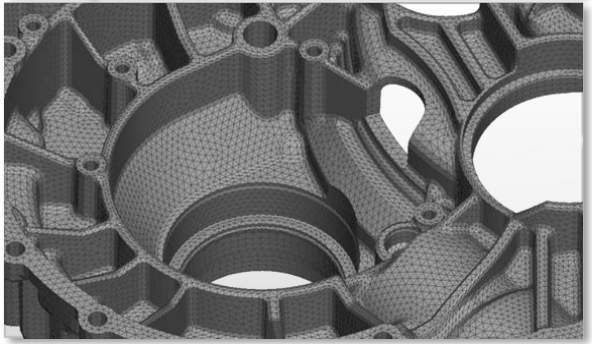


Shell Meshing Types

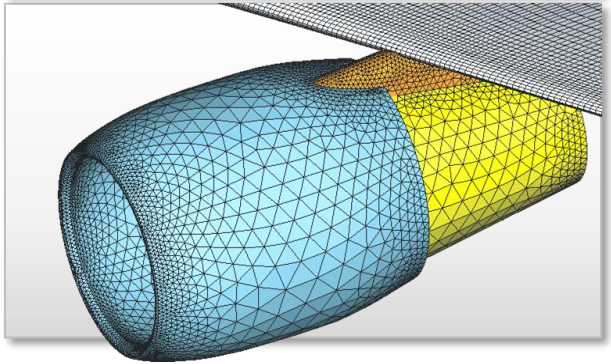
Surface Meshing



Structural Mesh for Solid components



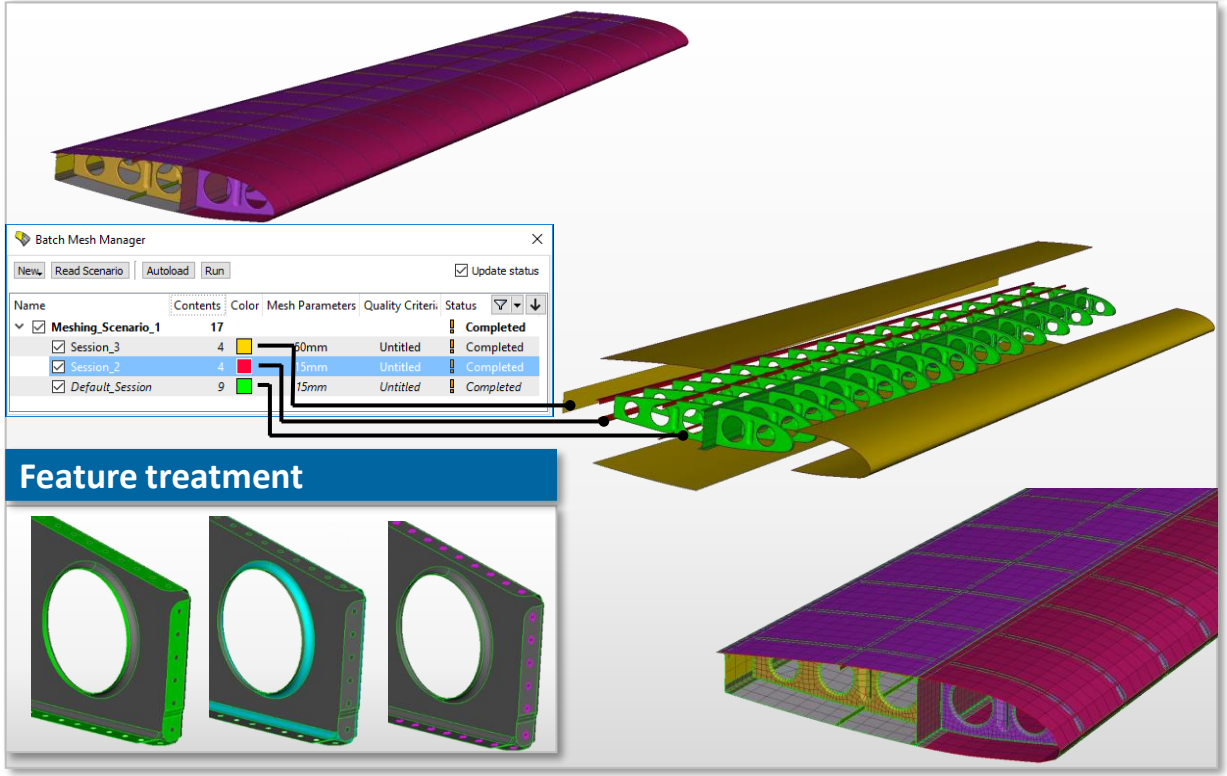
CFD Meshing



Wrapping



Batch Meshing

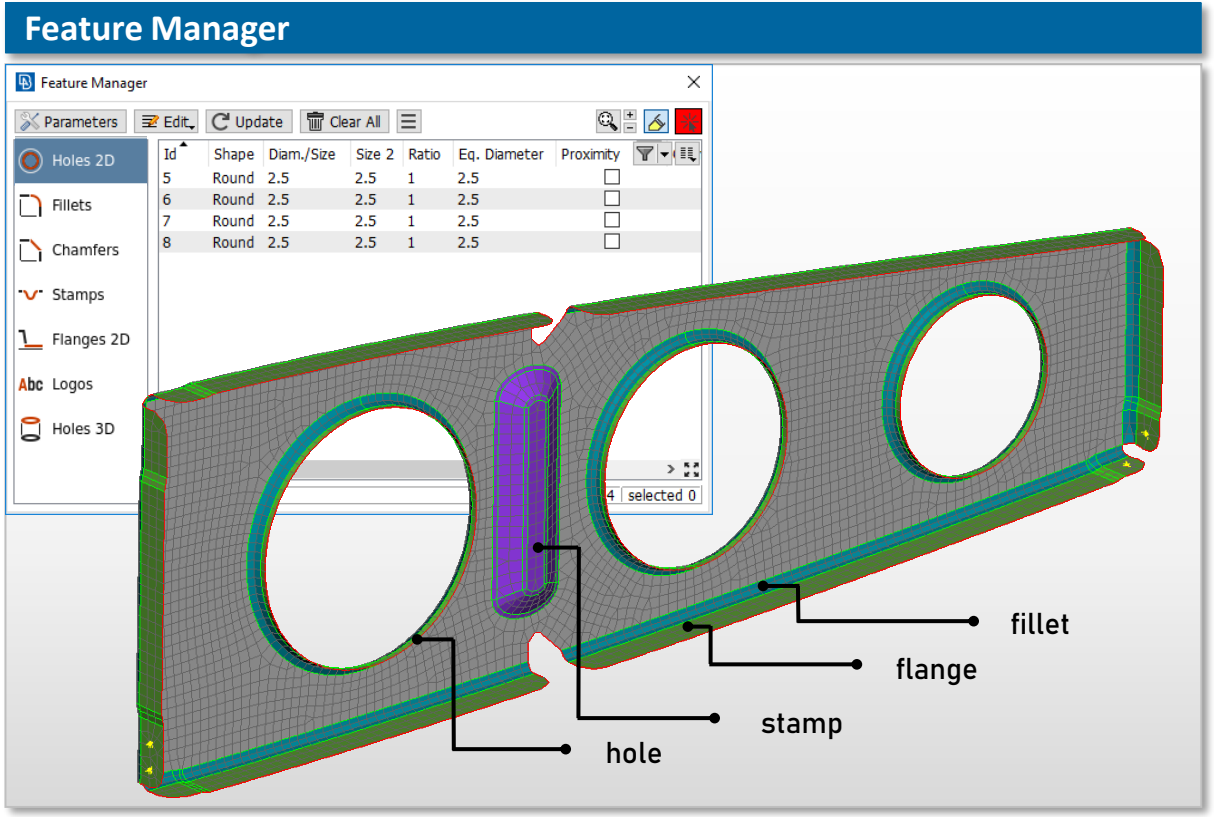


Feature treatment

Shell Meshing

- Definition of meshing parameters and quality criteria
- Features treatment and model simplification
- Automatic meshing and quality improvement

Feature Manager

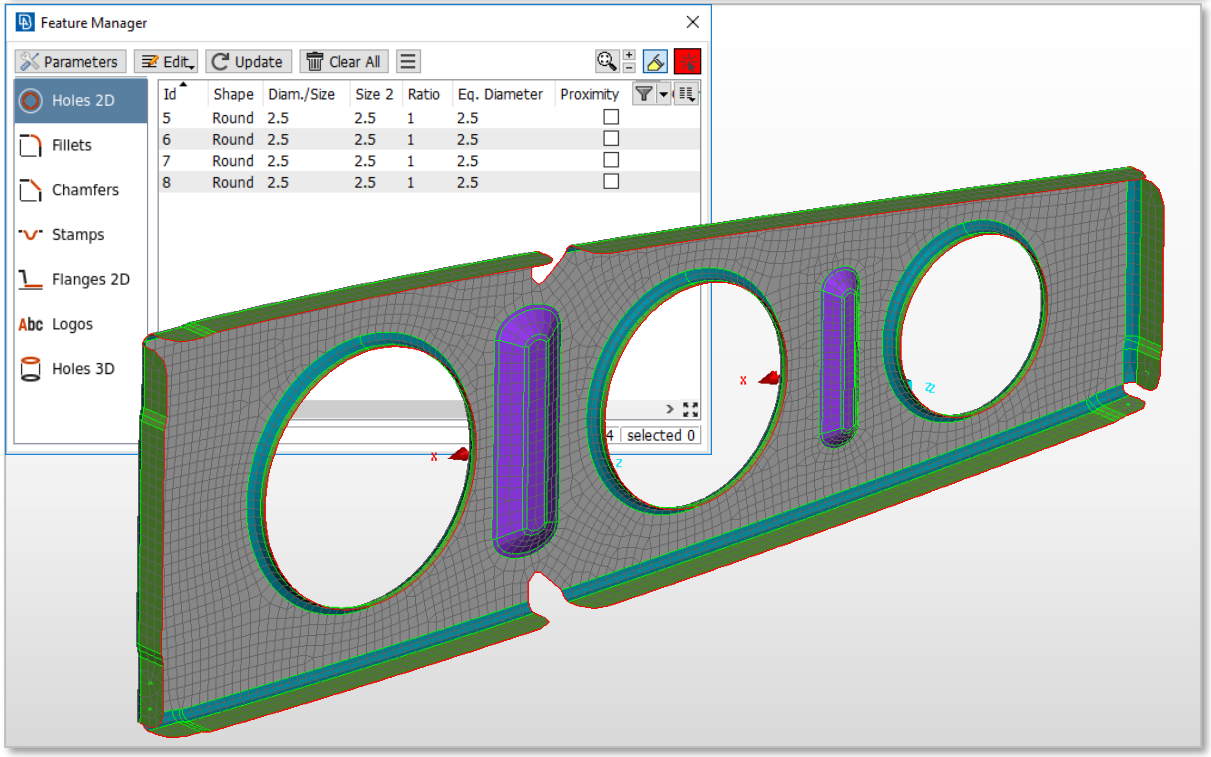


Shell Meshing

- Automatic recognition of features
- Features meshing treatment
- Features shape modification

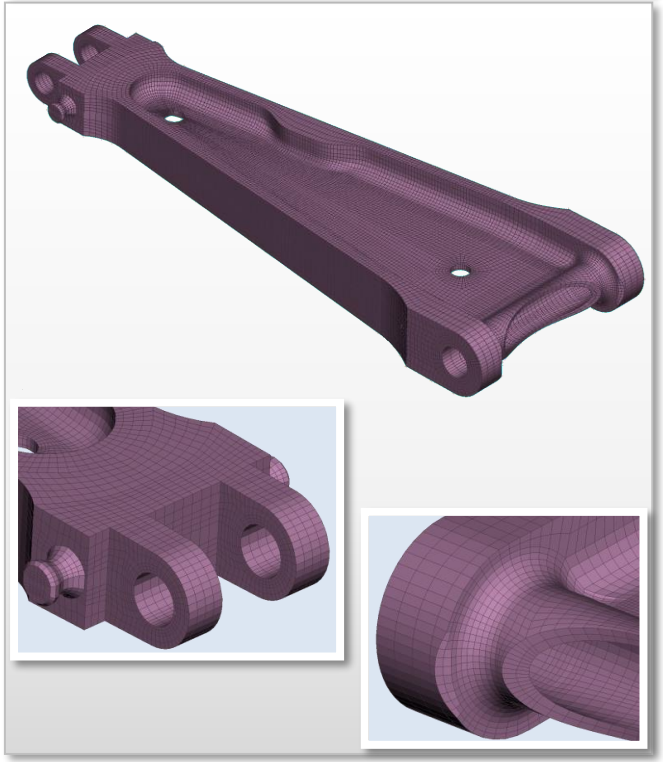
Shell Meshing

Feature Manager: Features shape modification

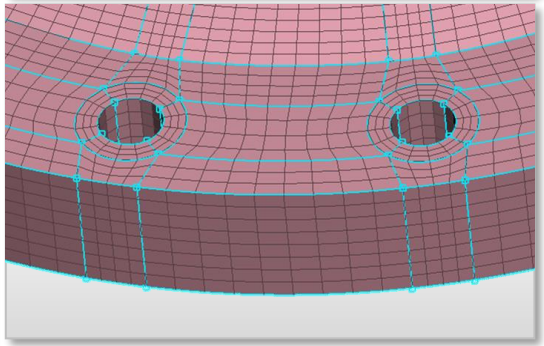


Hexa Block Tool

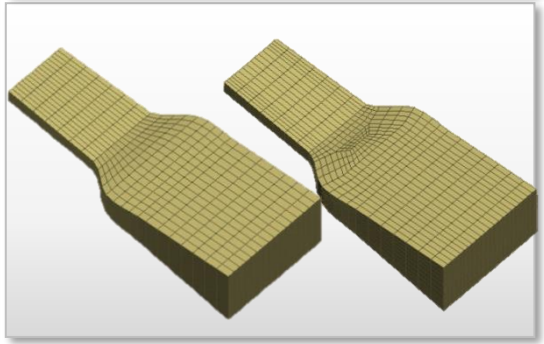
Structural models



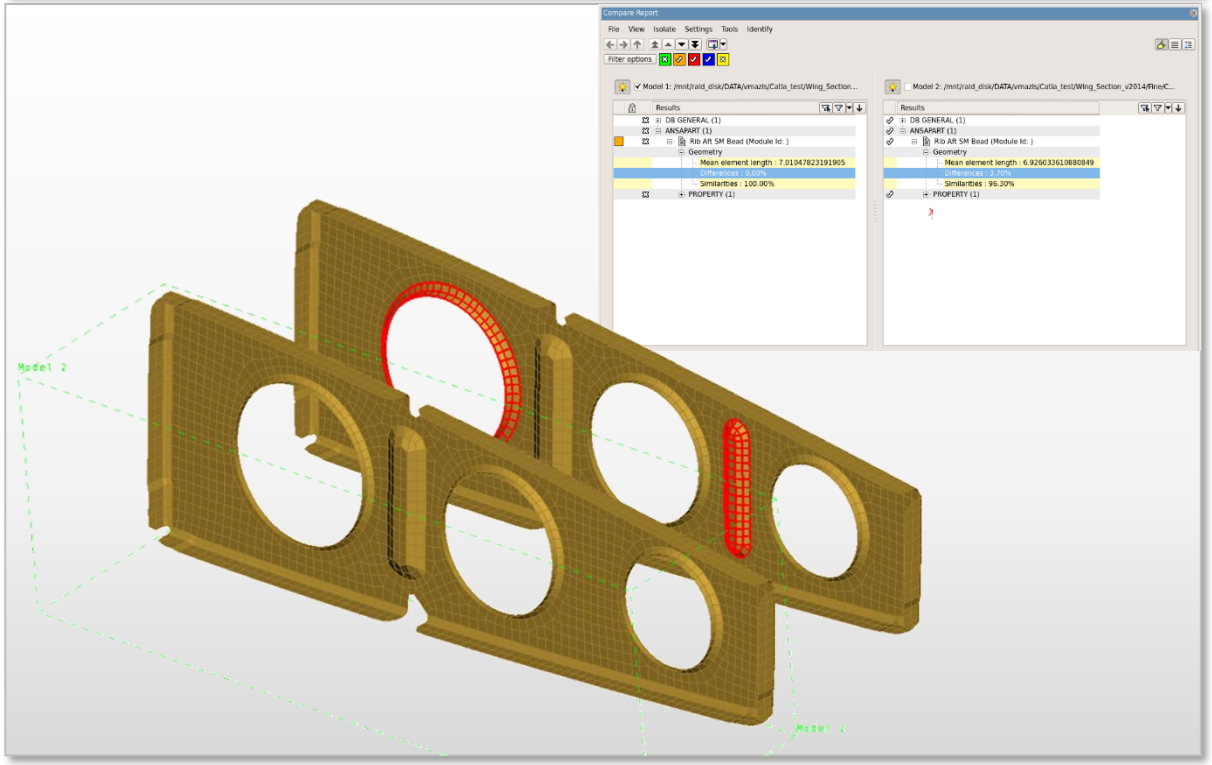
Element zones generation



C/L type structure generation

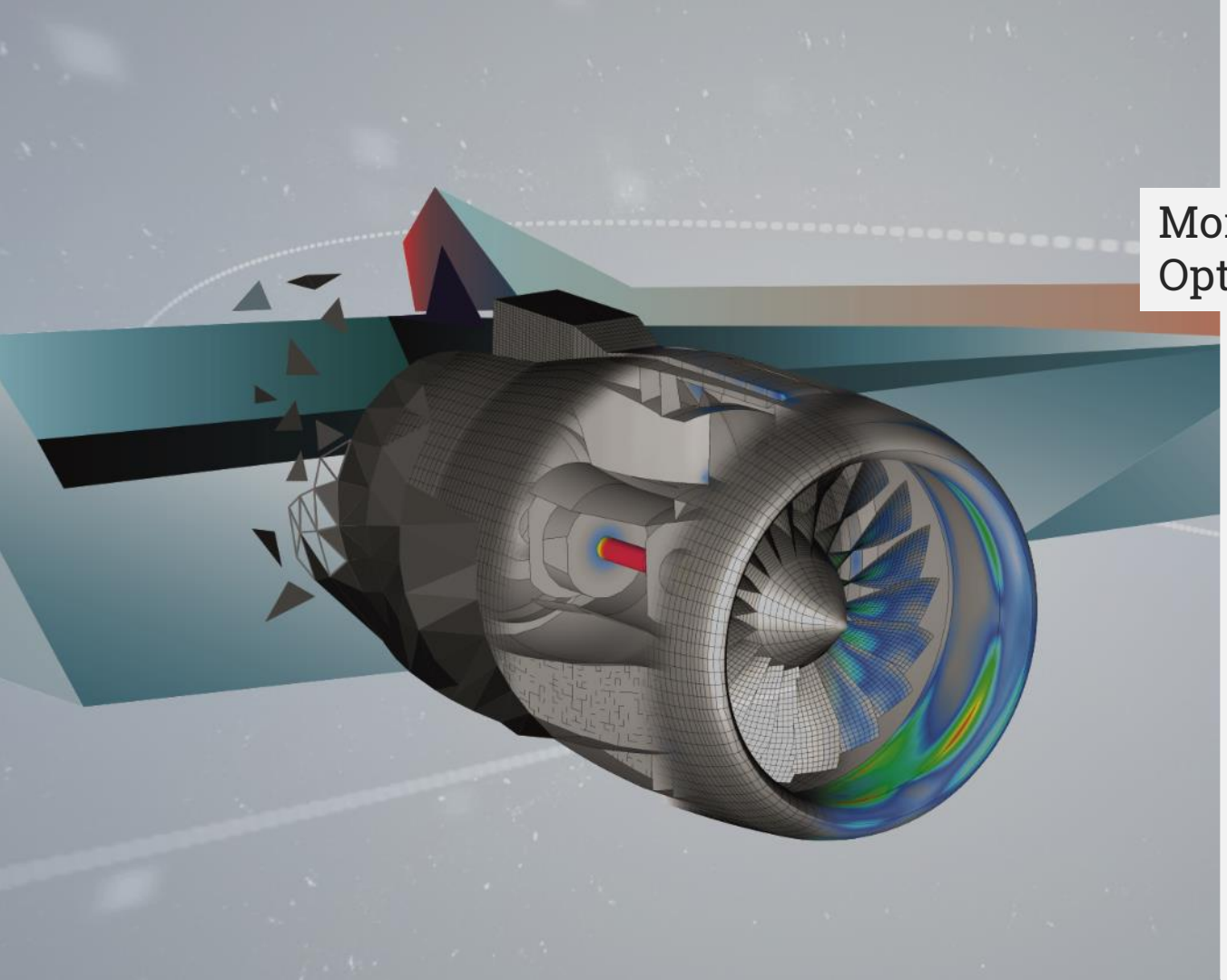


Compare Tool



Analysis Tools

- Explore differences
- Capture and re-use



Morphing - Optimization

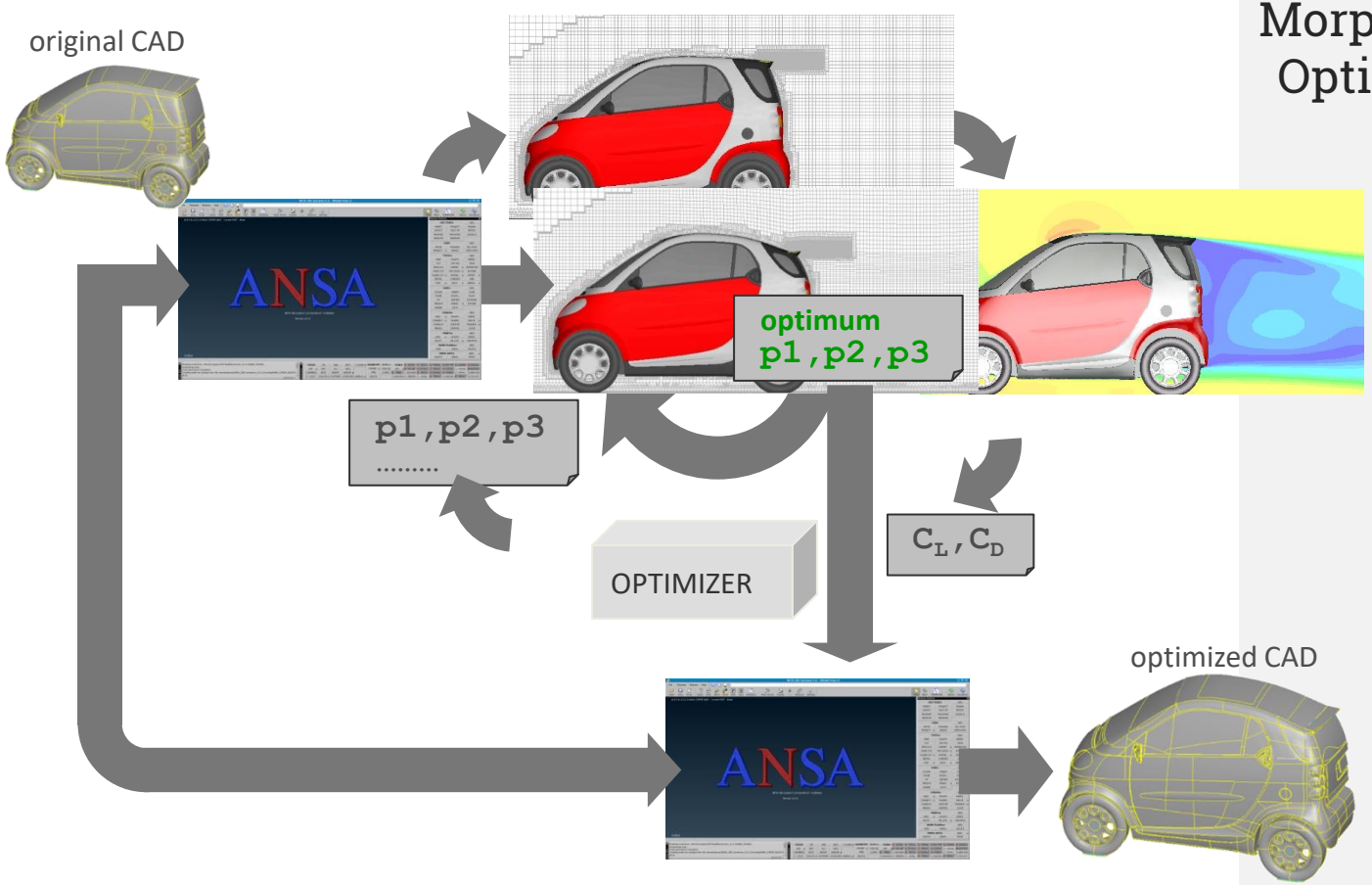
Agenda

- Parametric shape morphing for FE and geometry structures/surfaces using morph boxes.
- Parametric modifications of features like Beads, Stamps, and Openings
- Setting up optimization task for batch DOE and Optimization runs
- Setting up topology optimization
- Advanced morphing and concept design tools

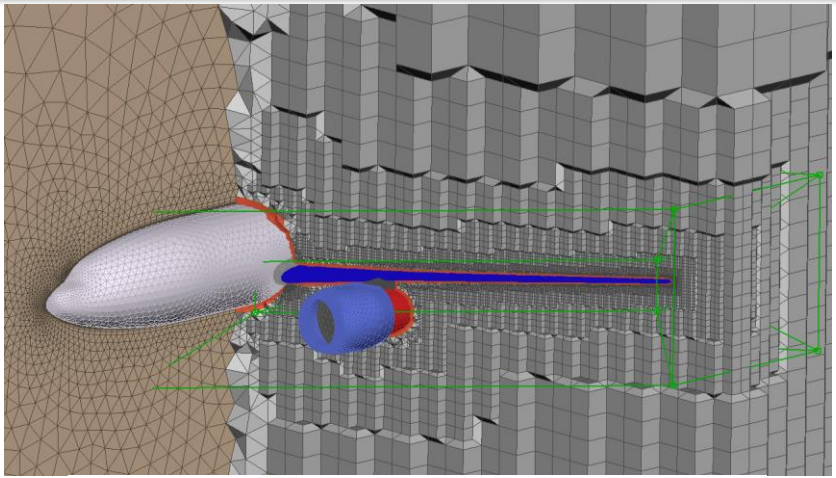
Morphing - Optimization

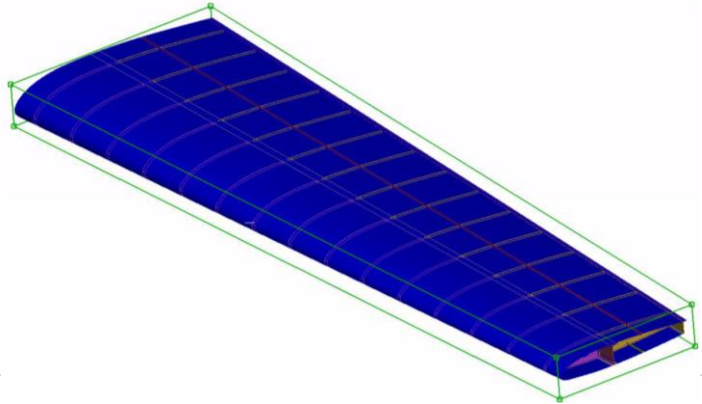
Morphing: Optimization loop

Morphing - Optimization Loop



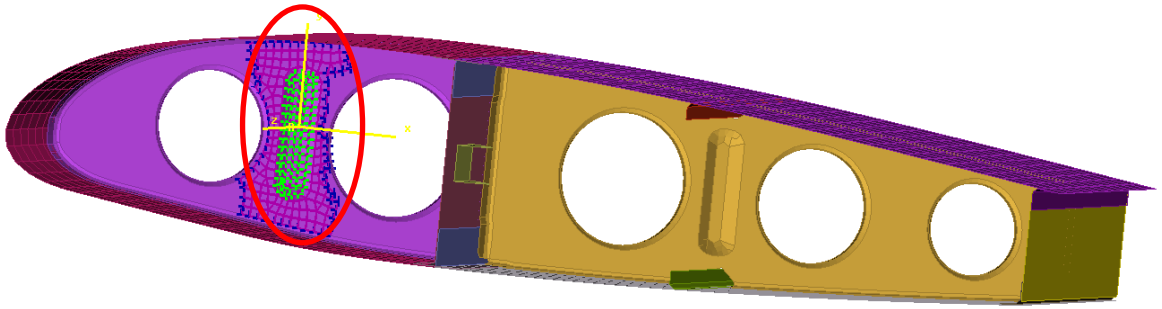
Box Morphing

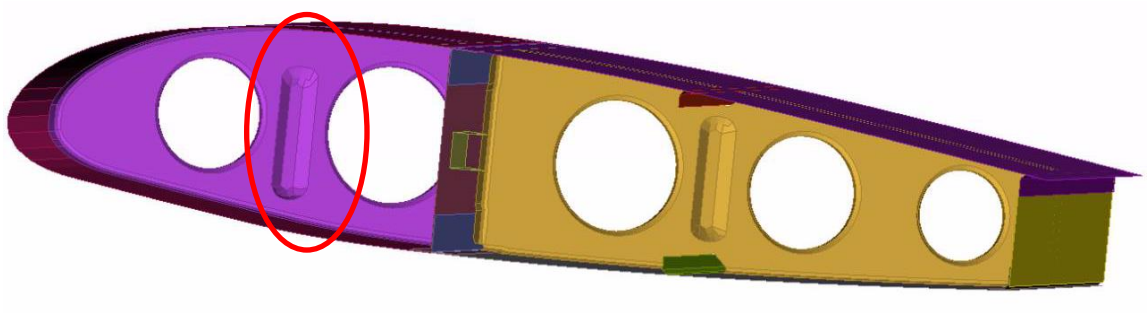




Morphing Strategies in ANSA

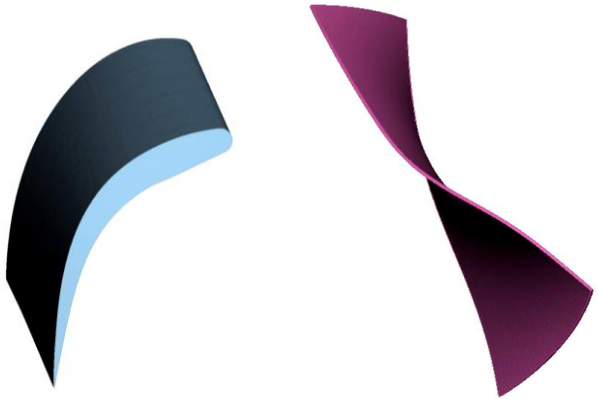
Direct Morphing

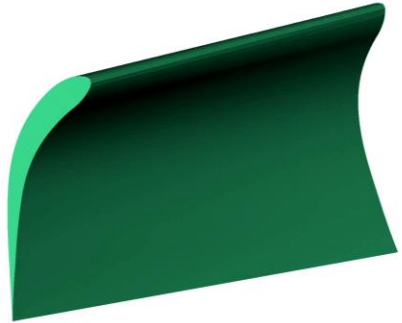


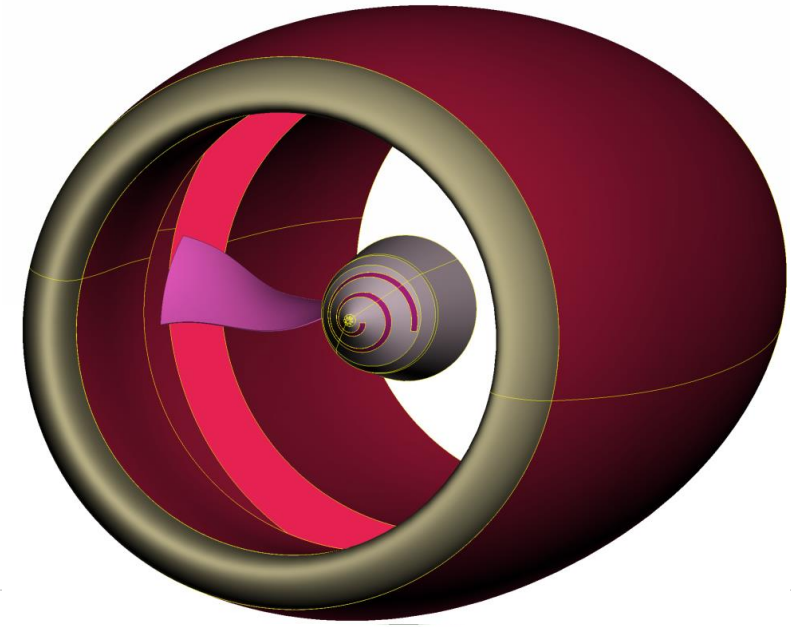


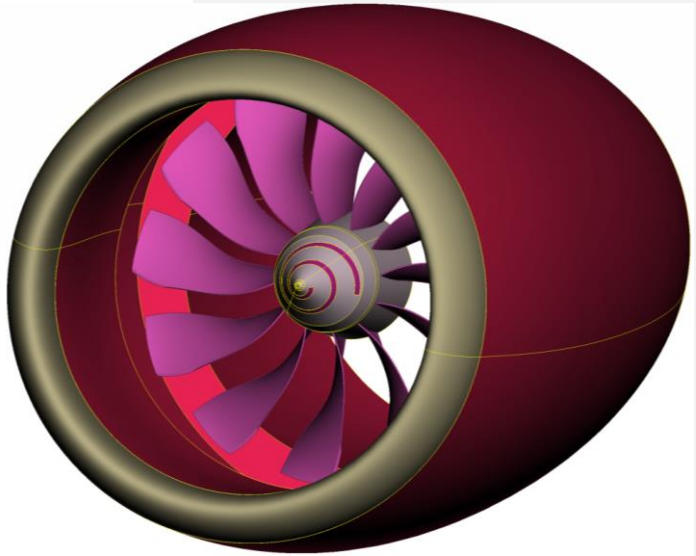
Morphing Strategies in ANSA

Blades Morphing for shape optimization



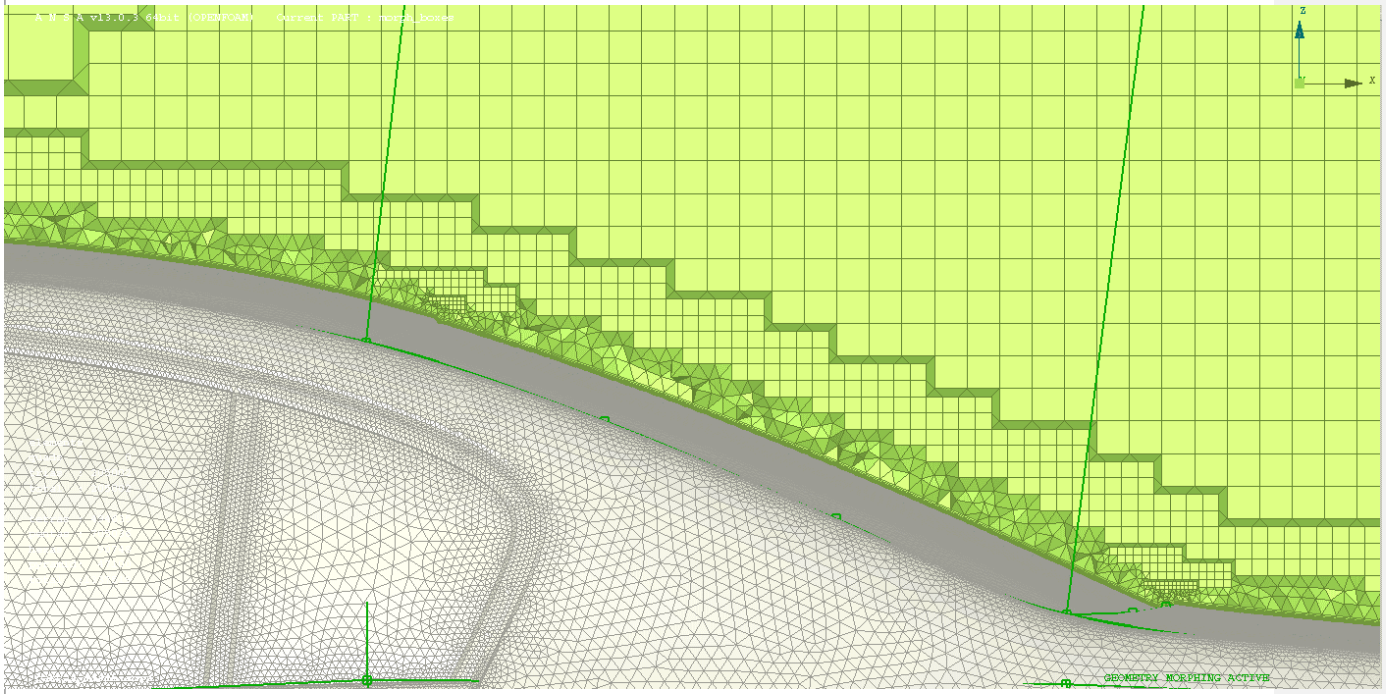




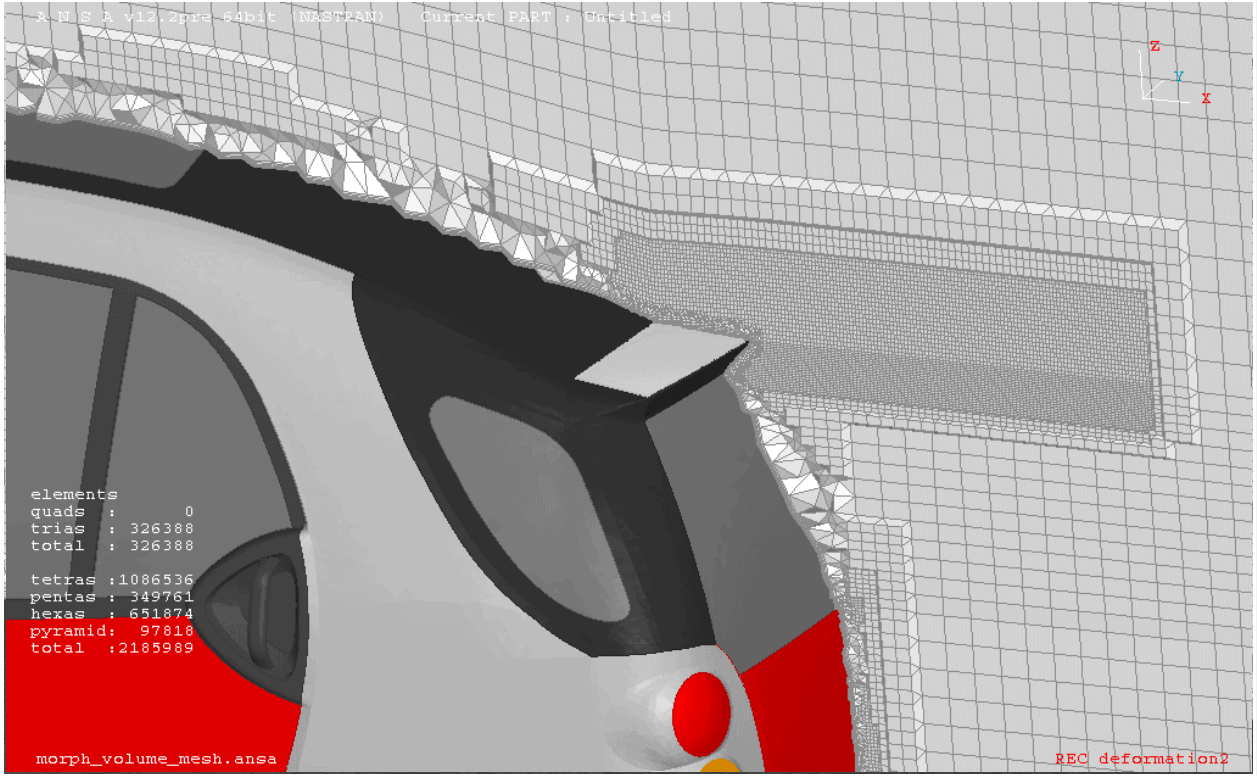


Mesh morphing of rear windscreen of Passat car for Aerodynamic performance

Box Morphing Application

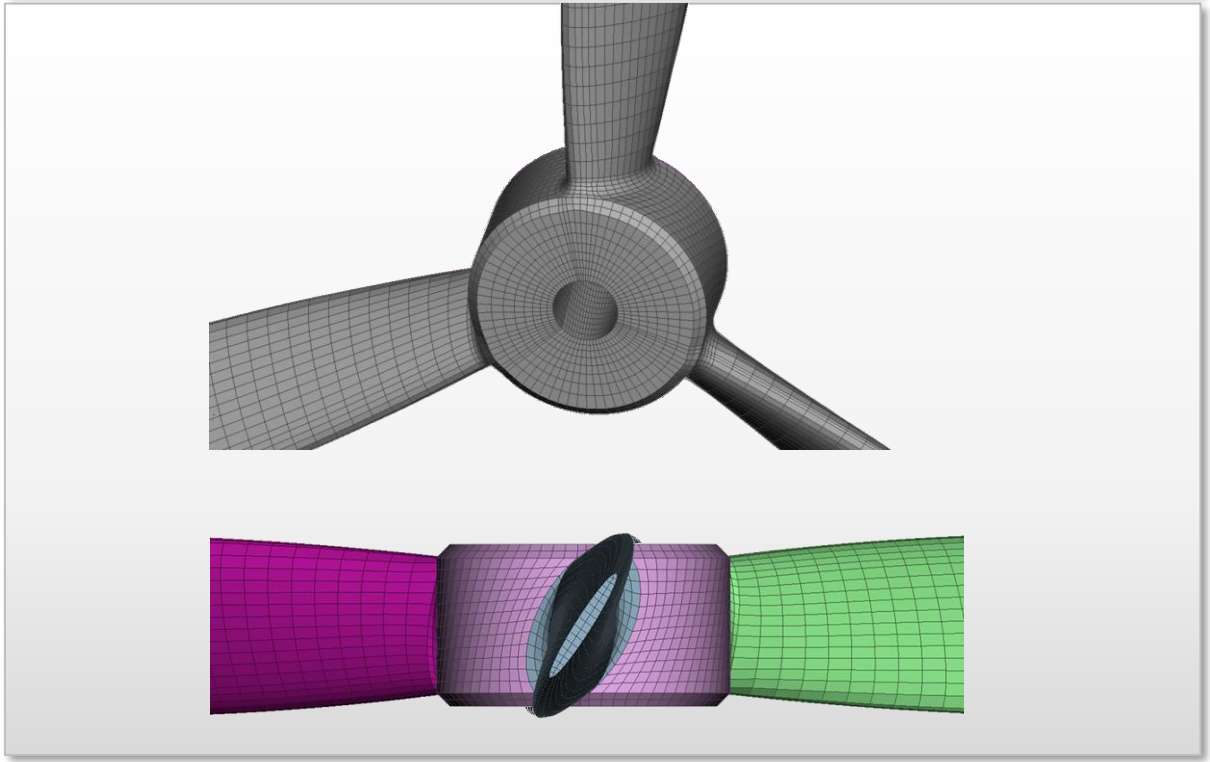


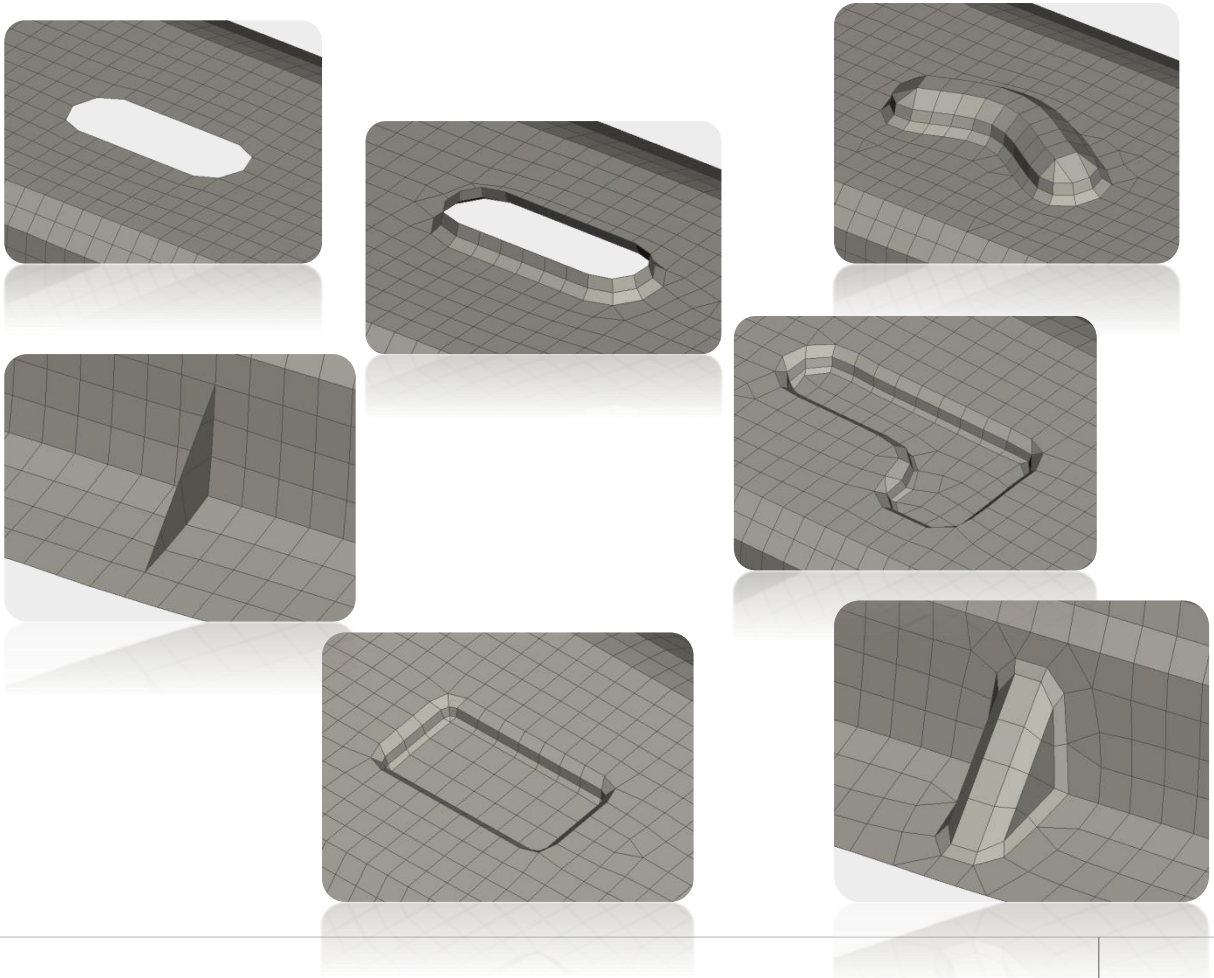
Morphing – External Aero



Box Morphing Application

Direct Morphing

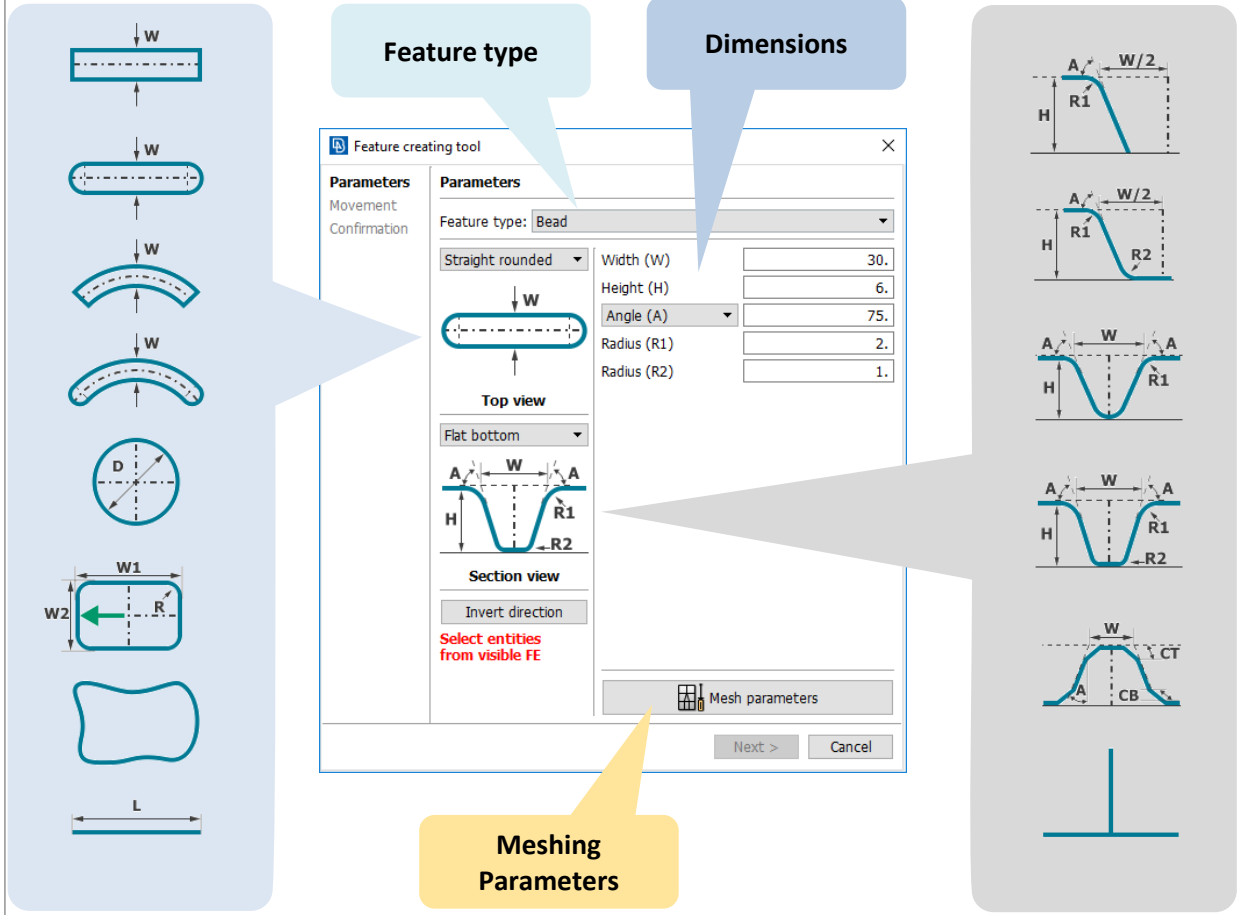




Create Features

Openings
Flanged Openings
Beads
Stamps
2D Ribs
3D Ribs
Solid Ribs

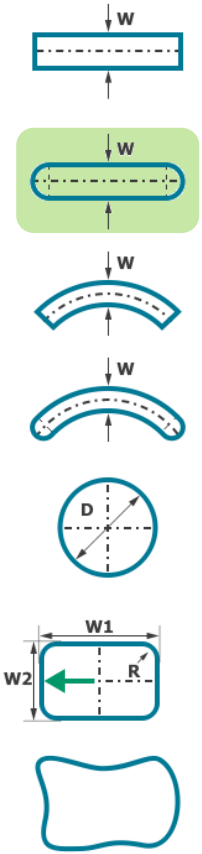
Create Features

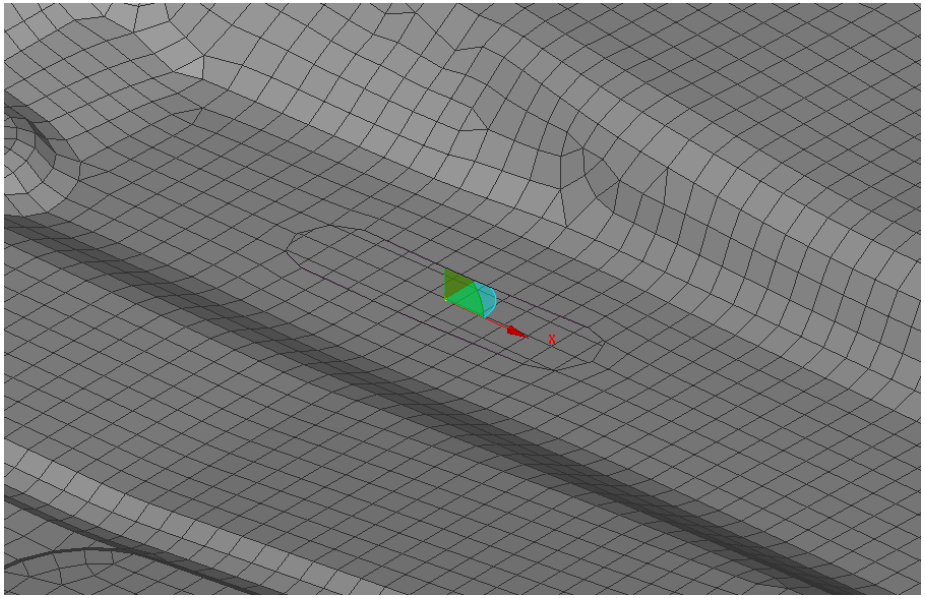


Definition of
- Feature type
- Shape
- Section
- Dimensions
- Meshing Parameters

Create Features

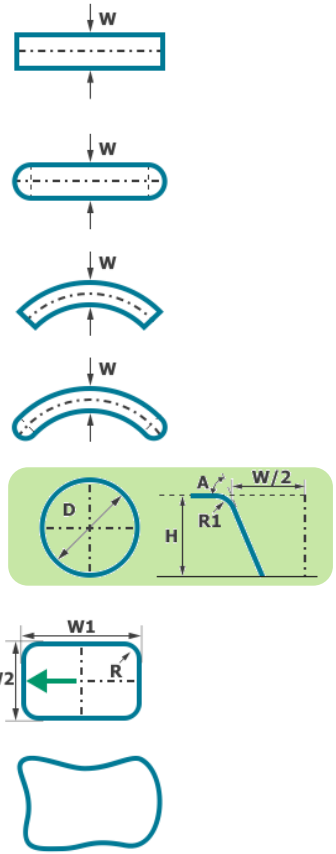
Straight Rounded Opening

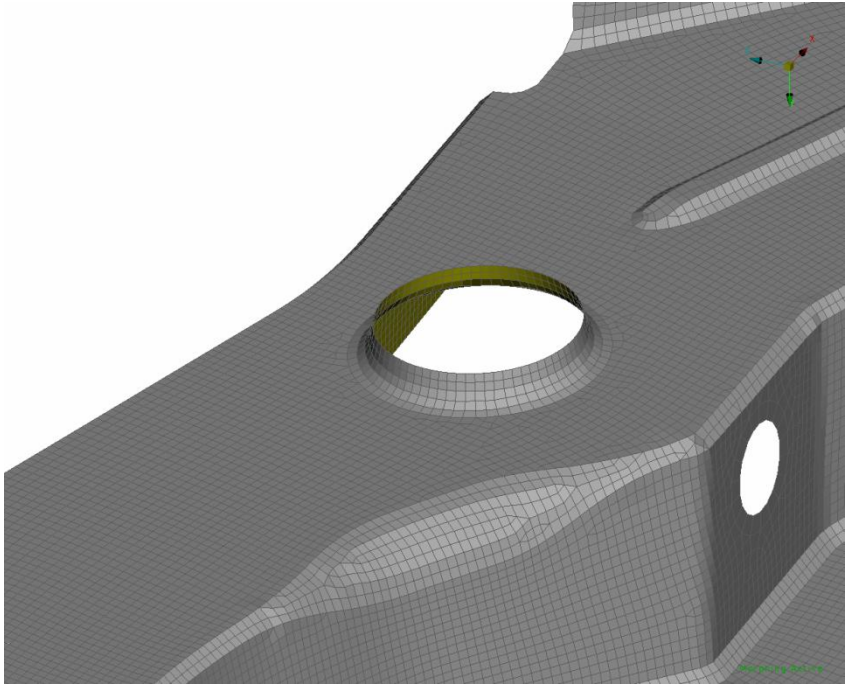




Create Features

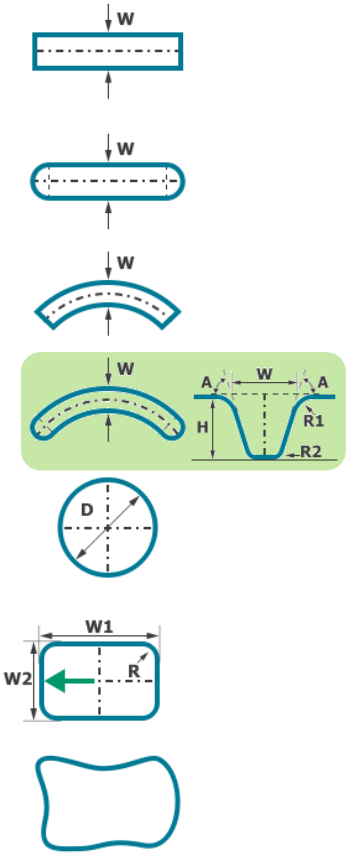
Flanged Circular Opening

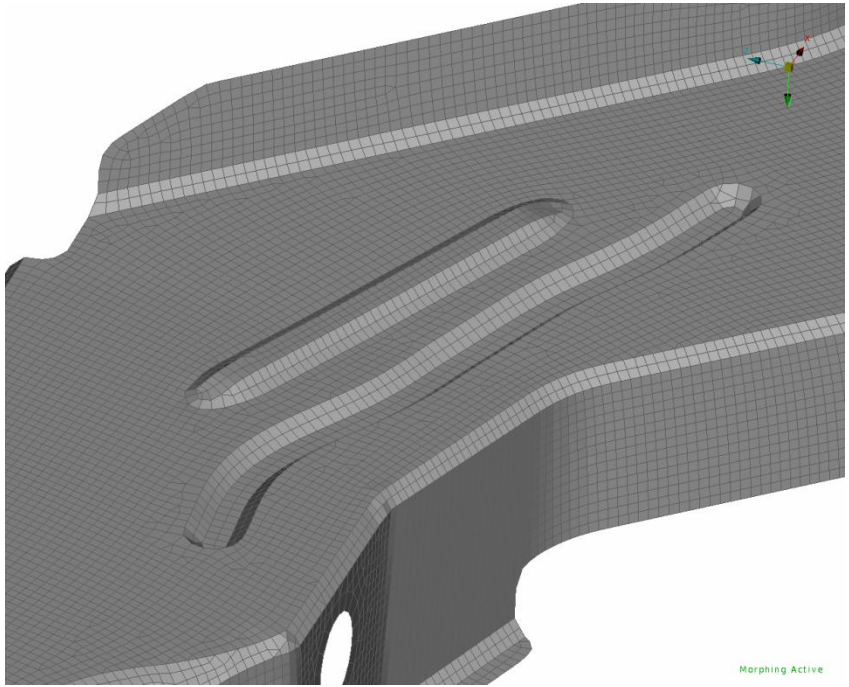




Create Features

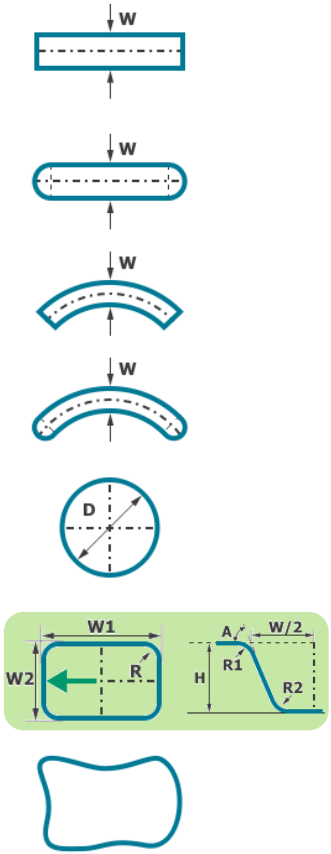
Curved Rounded Bead

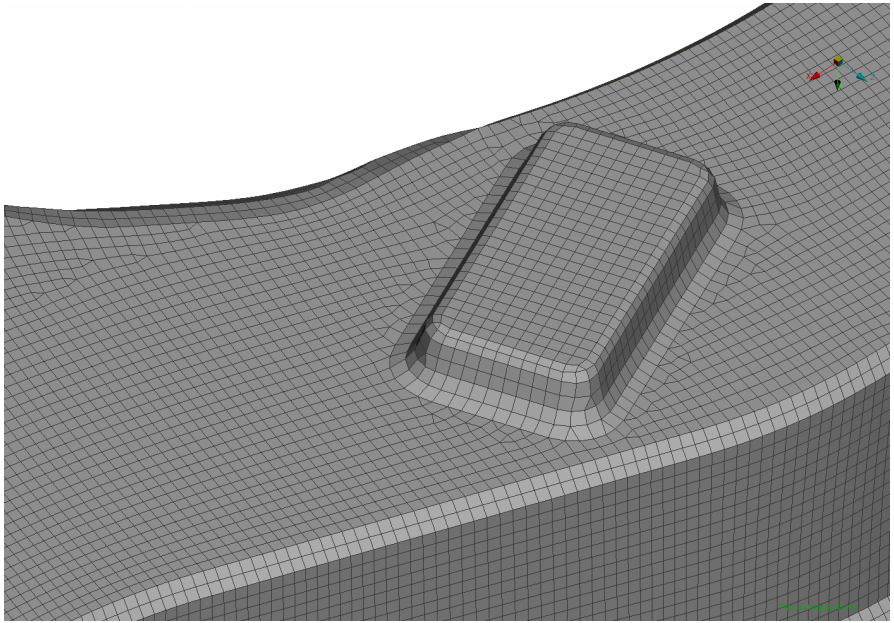




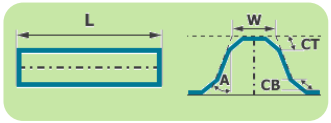
Create Features

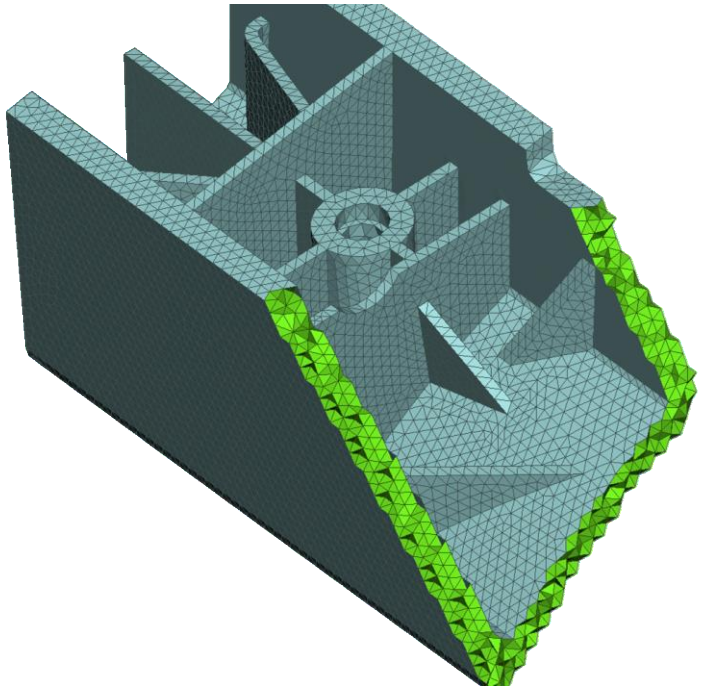
Stamp Rectangular











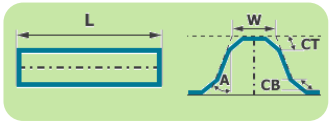
Create Features

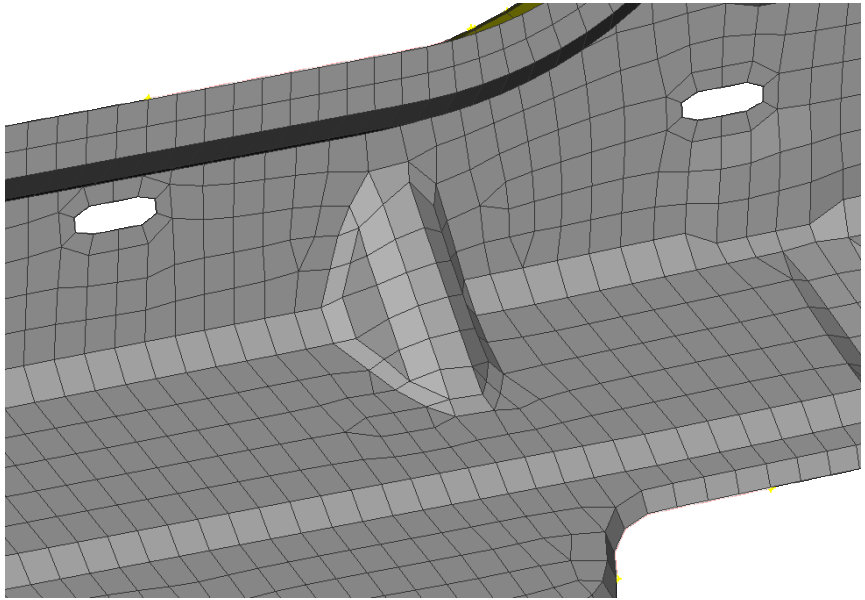
Rib Solid

Create Features

3D Rib on shells

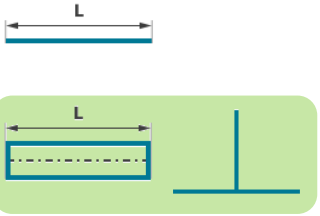


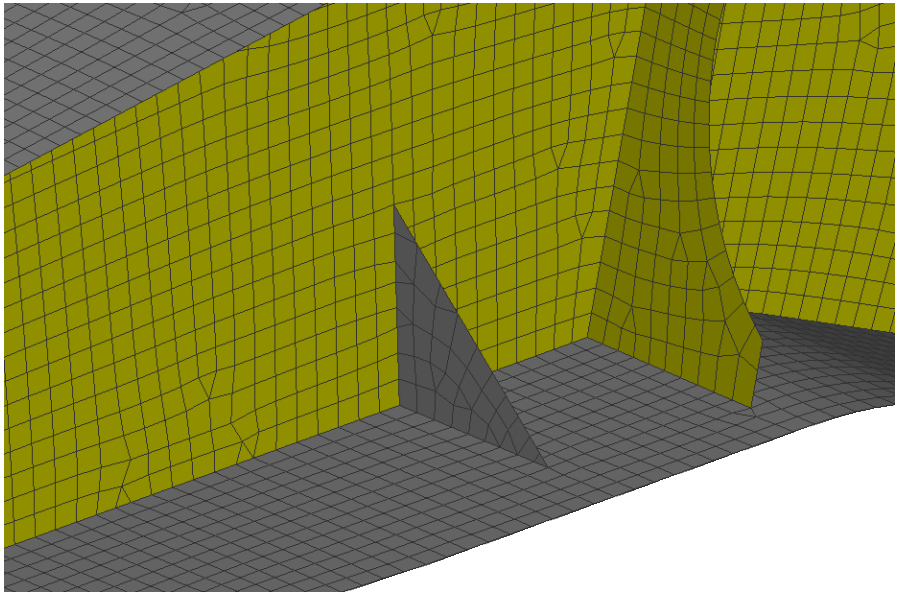




Create Features

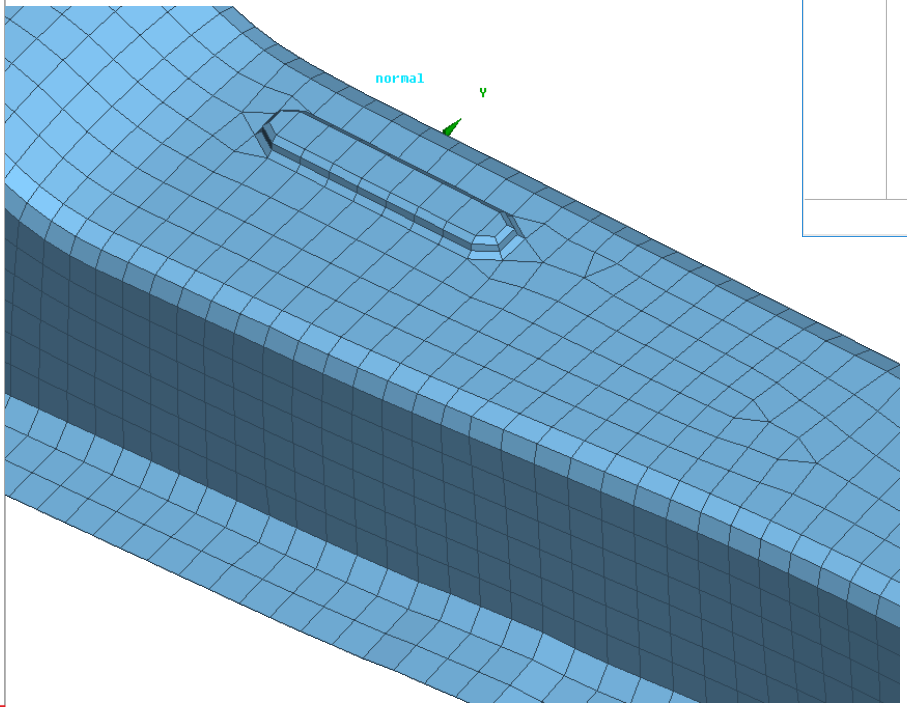
2D Rib on shells

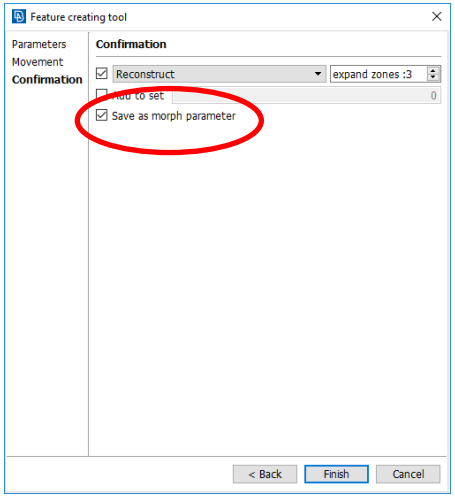




Parameterize Features

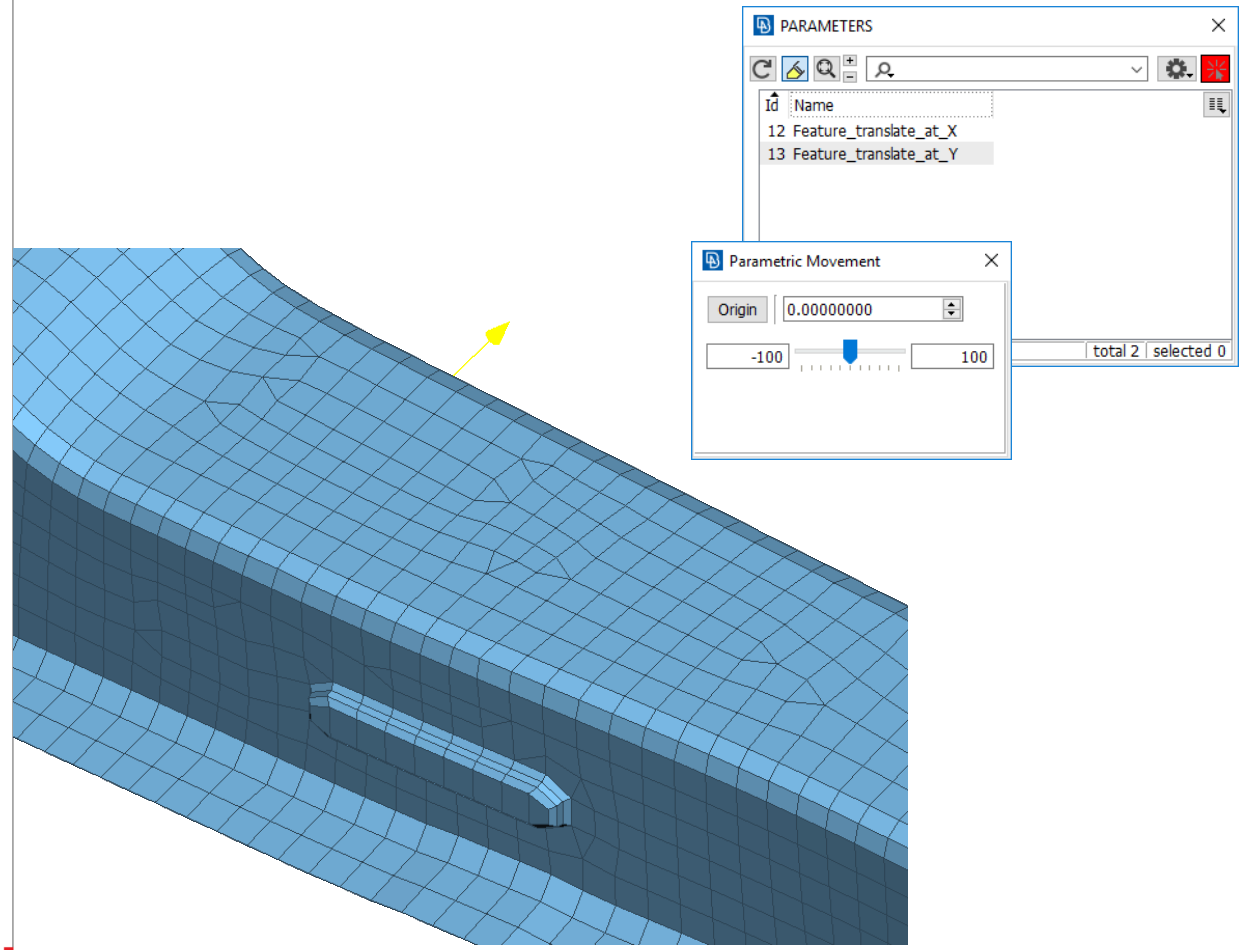
Automatic definition of morphing parameters for created features



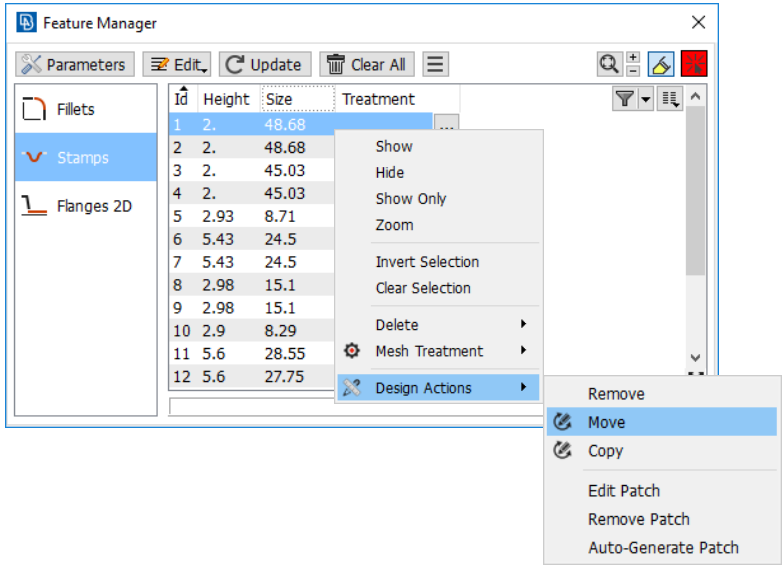


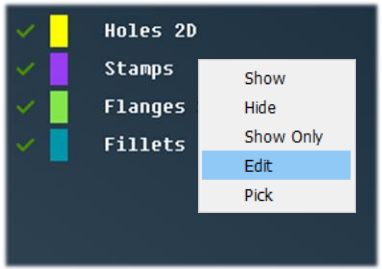
Parameterize Features

Automatic definition of morphing parameters for created features



Modify Features





Through the Features Manager

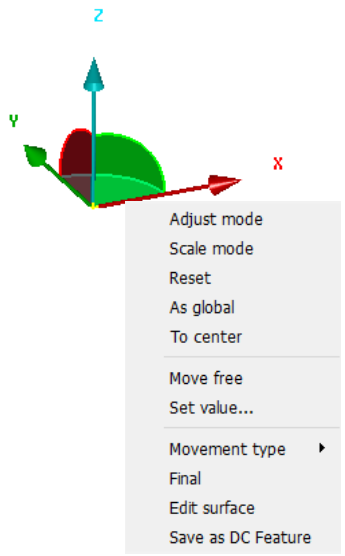
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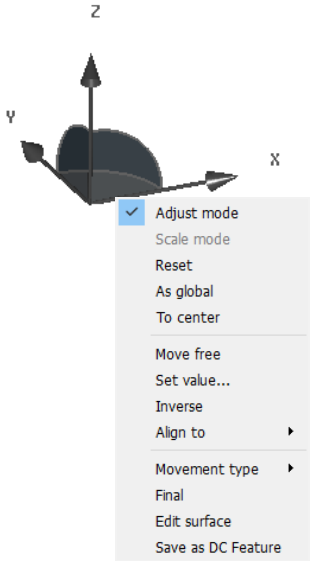
On screen menu

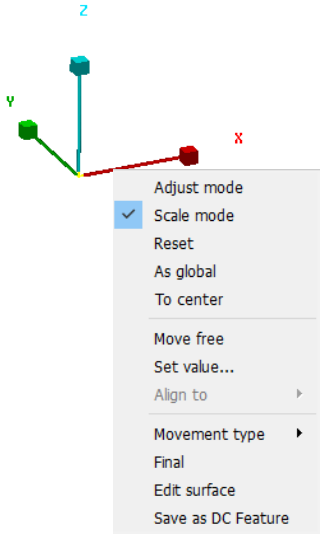
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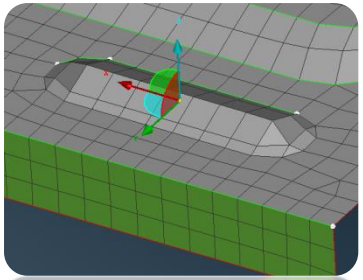
Through the Morphing Tool > Design Changes

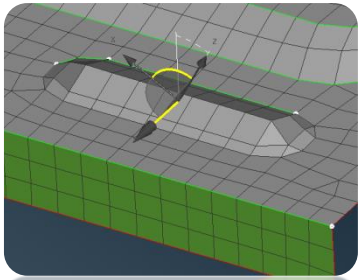
Modify Features

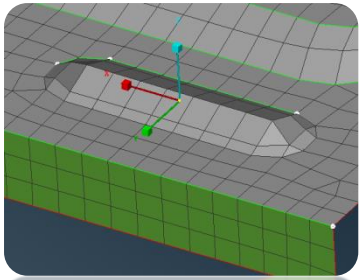










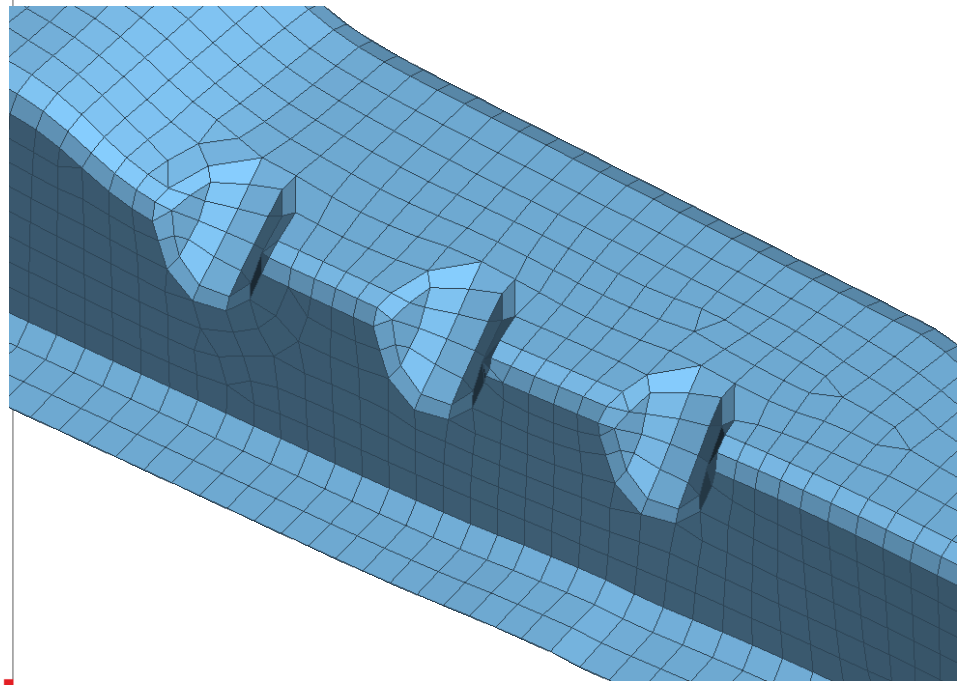


Using of multifunctional compass for

-Modify feature
-Adjust coordinate system
-Scale feature

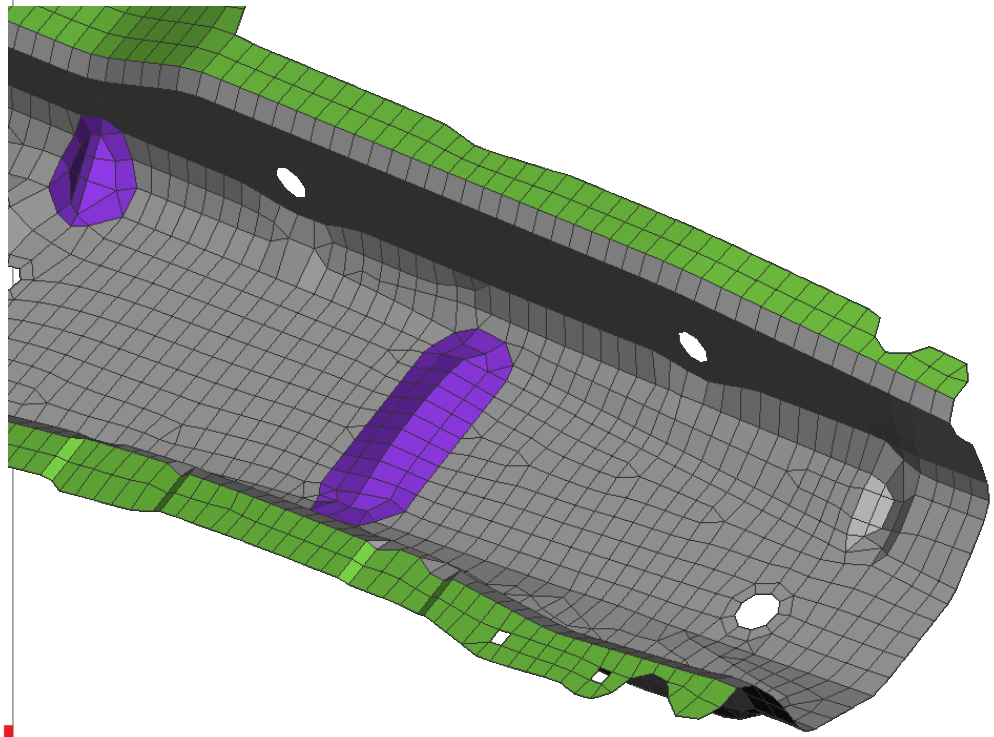
Modify Features

Copy Features



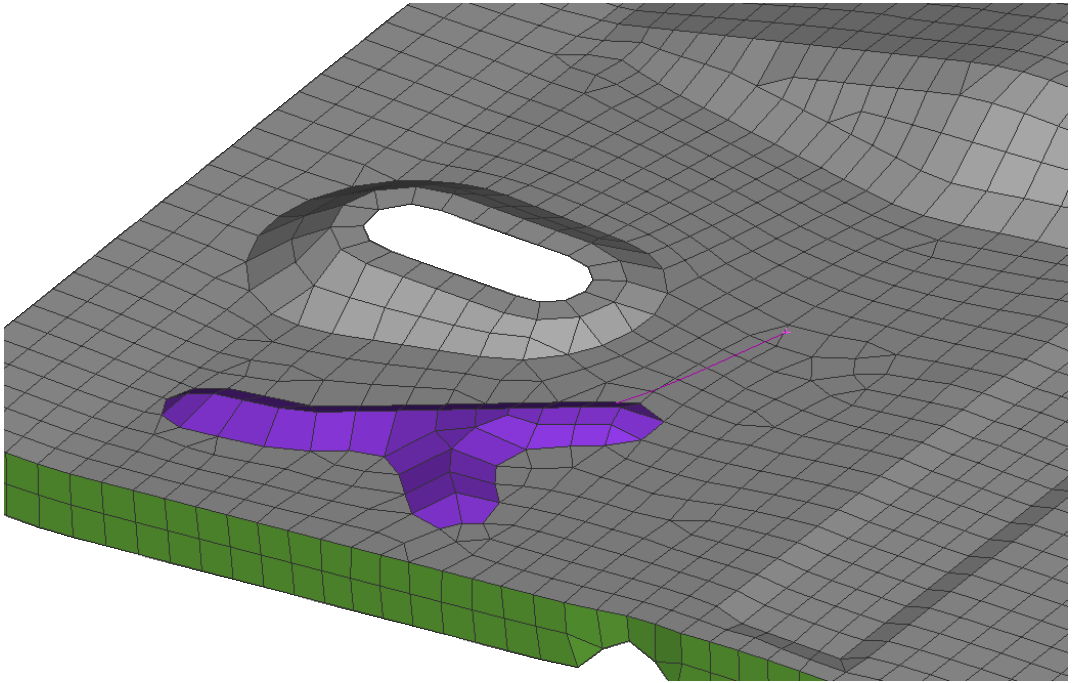
Modify Features

Translate - Scale



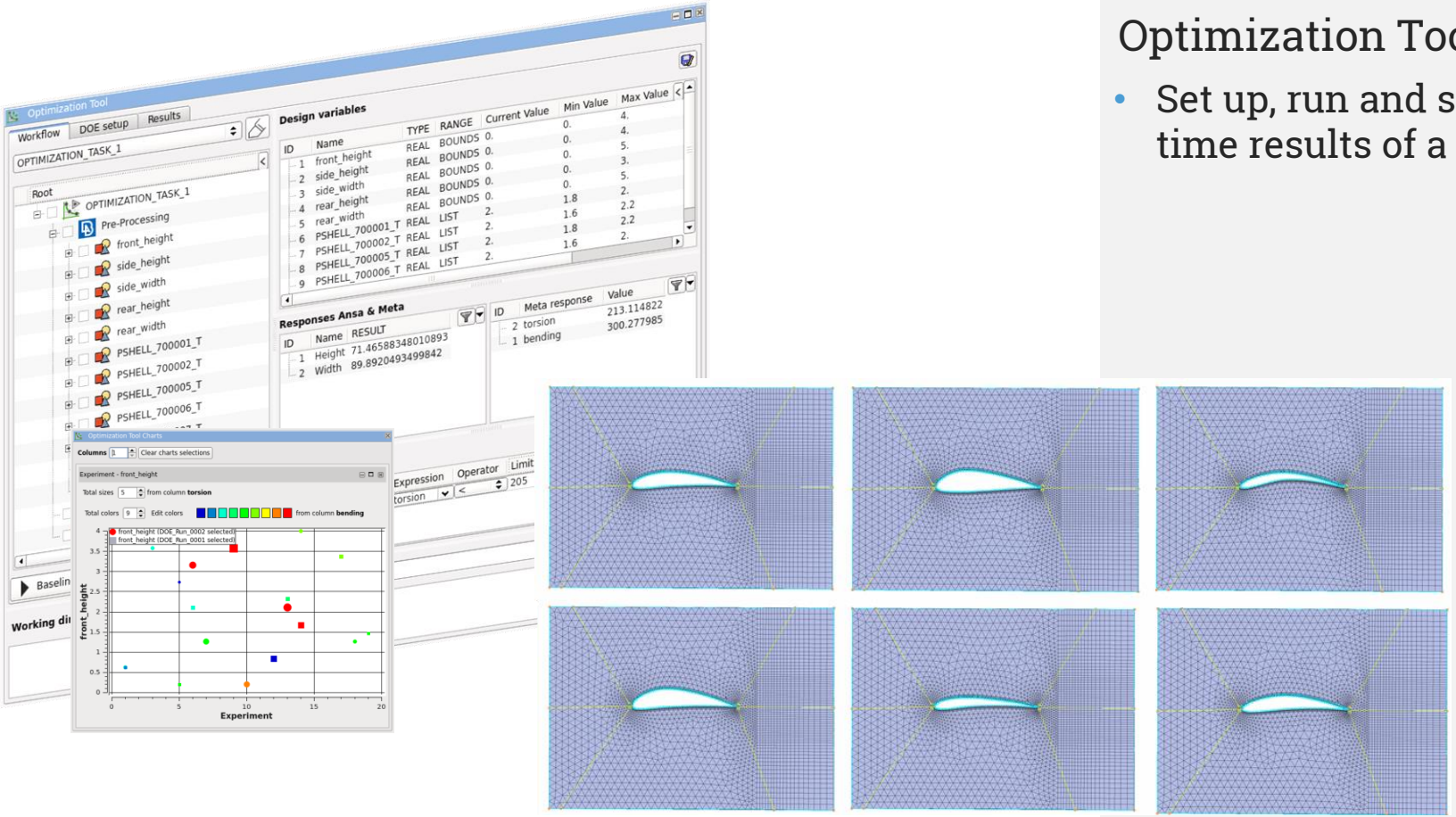
Modify Features

Follow Path



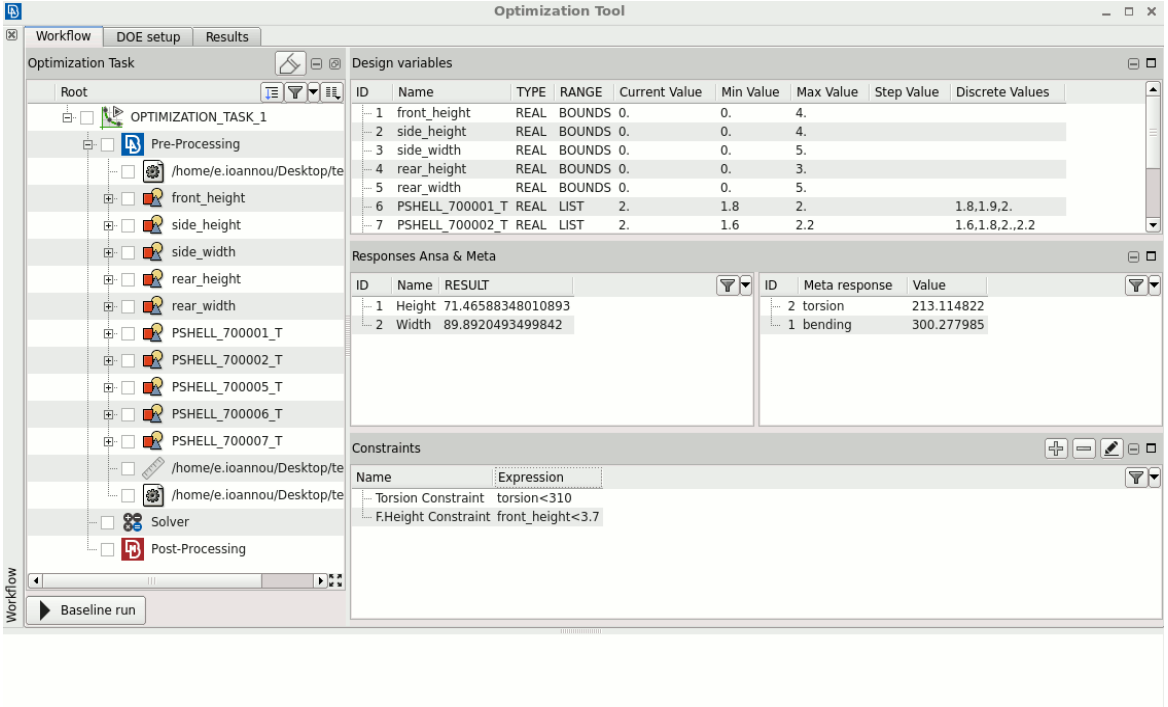
Optimization Tool

- Set up, run and see real-time results of a DOE



Optimization Tool

- Set up, run and see real-time results of a DOE



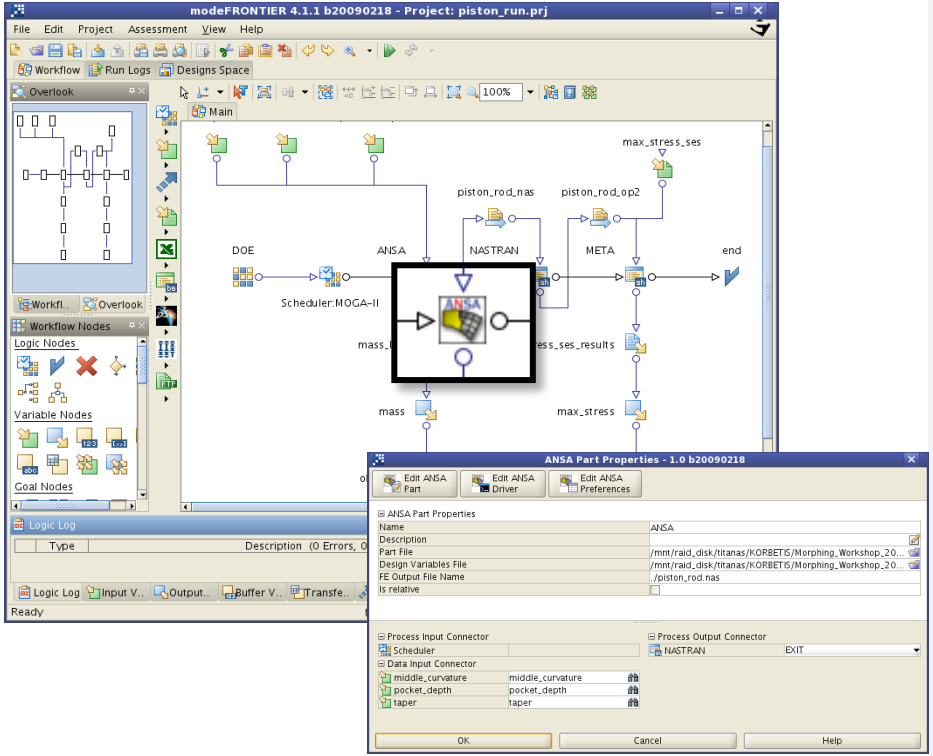
Coupling with optimization software

modeFRONTIER

HEEDS

Isight SIMULIA

LS-OPT LSTC Livermore Software Technology Corporation



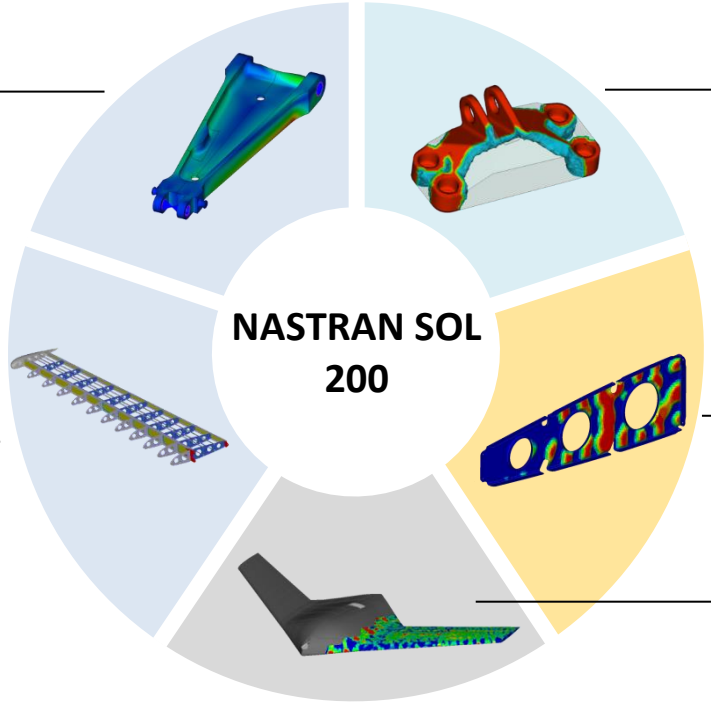
NASTRAN SOL 200 Optimization

Shape

Automated through Morphing Tool

Size

Element, Material and Connectivity Properties



Topology

Automatic smooth model definition

Topography

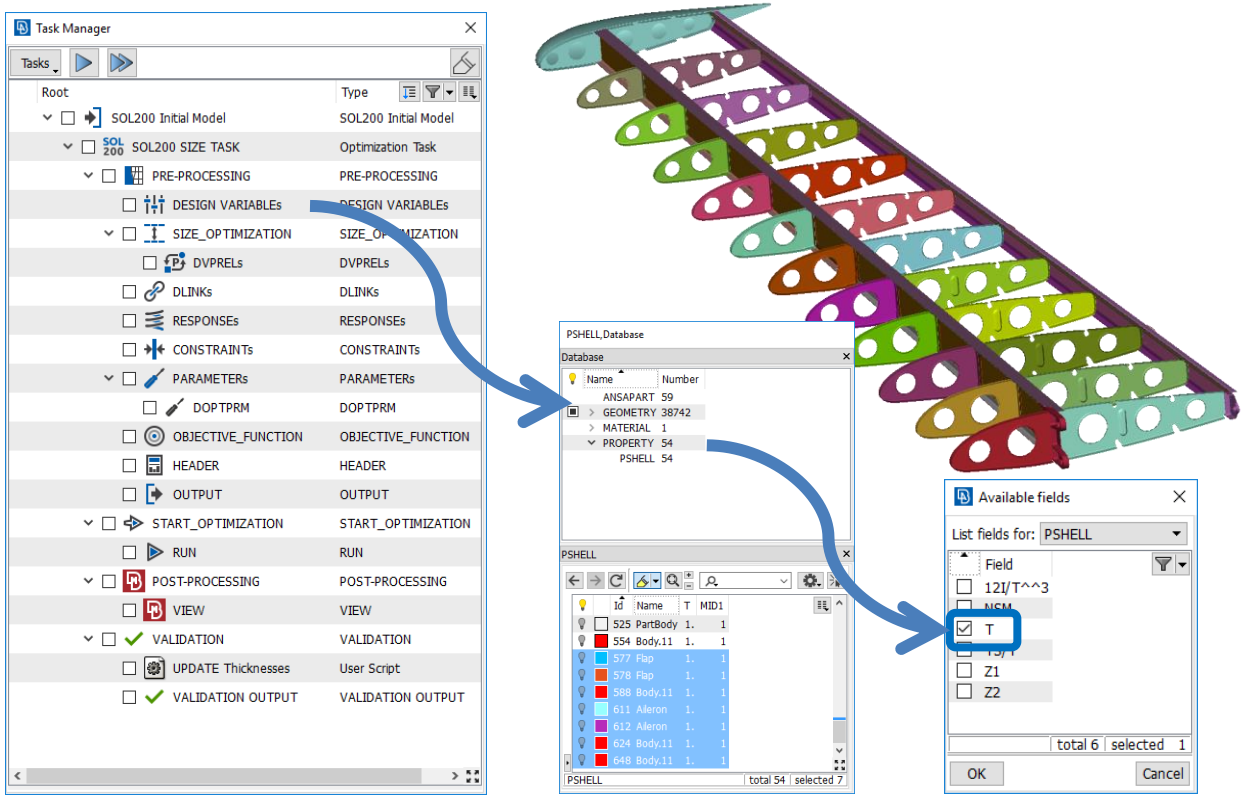
Creating beads

Topometry

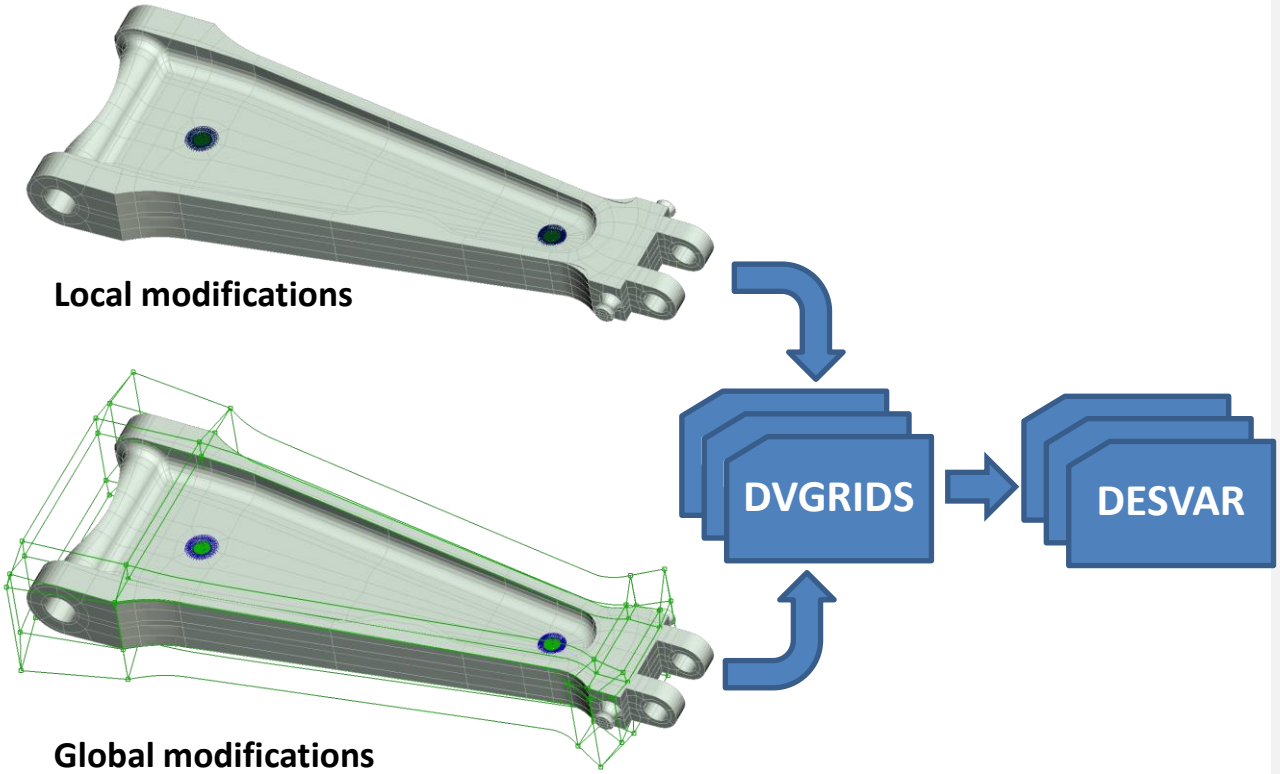
Thickness detailed optimization

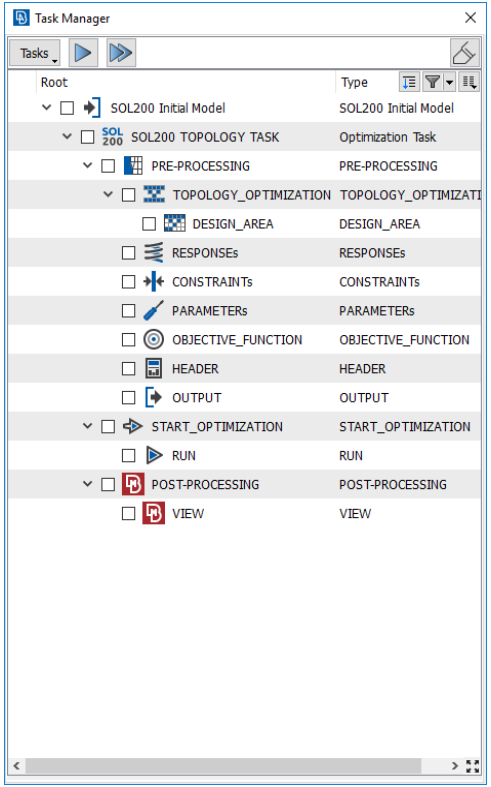
SOL 200 Size Optimization

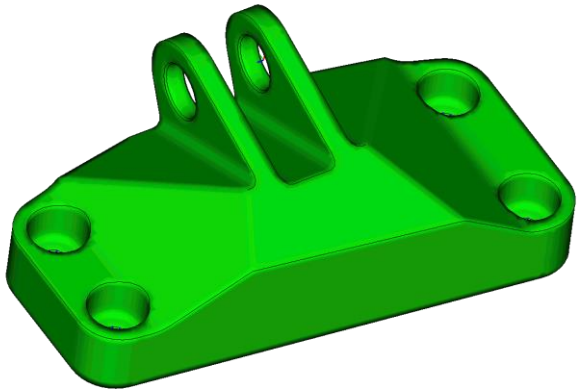
- Massive definition of design variables
- Automatic definition of DVPREL



SOL 200 Shape Optimization

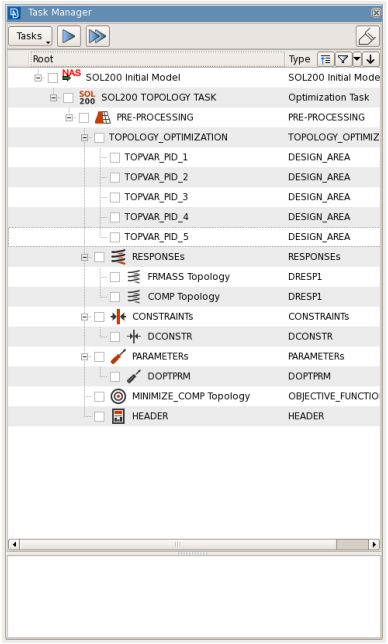


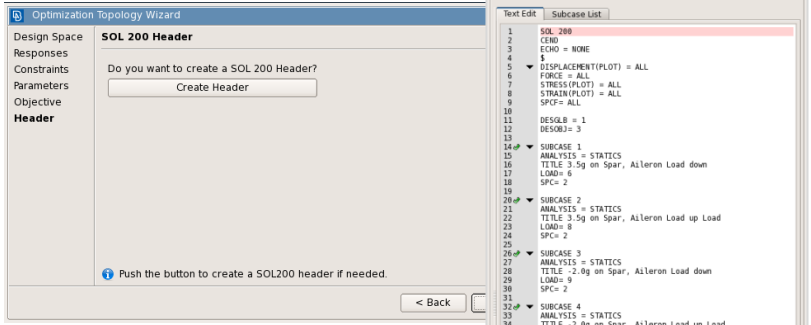


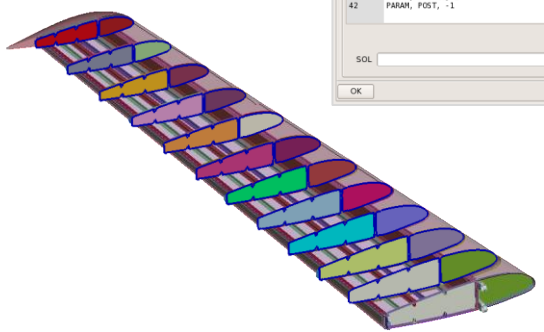


SOL 200 Topology Optimization

- Composite
- Constraints
- Automatic smoothing action
- Automatic validation model definition



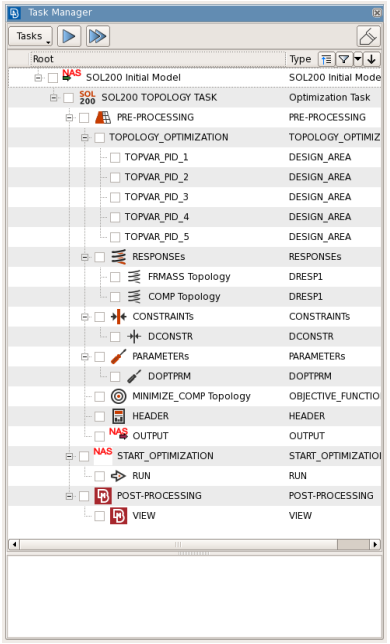


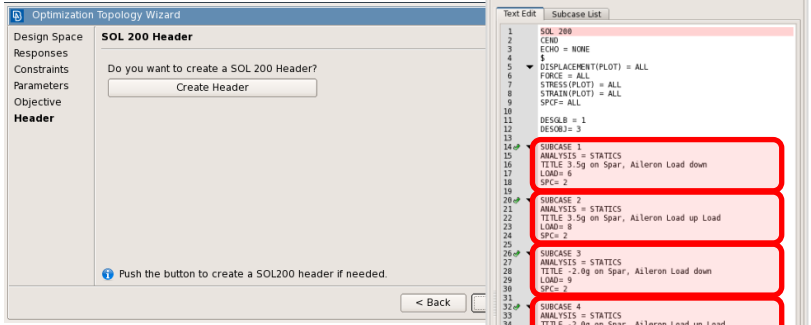


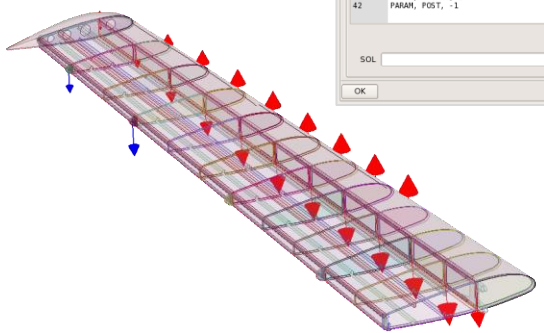
SOL 200 Topology Optimization: Embedded Task Wizard

Defines:

- Design Space
- Design Responses
- Constraints
- Optimization Parameters
- Objective function
- Auto complete Header





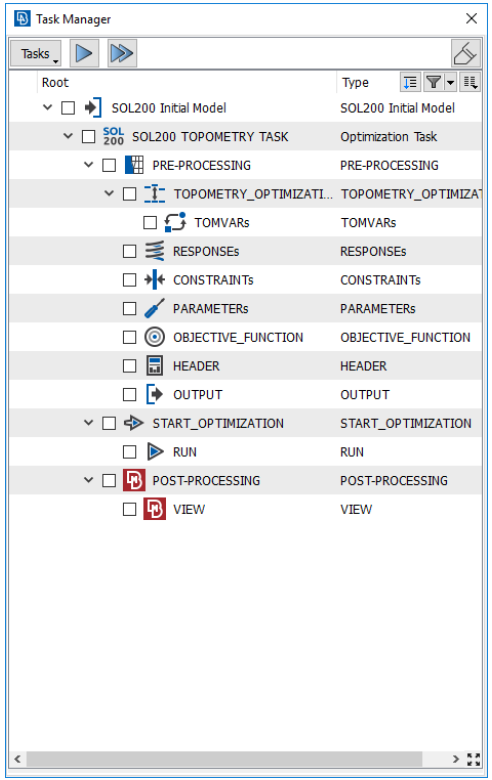


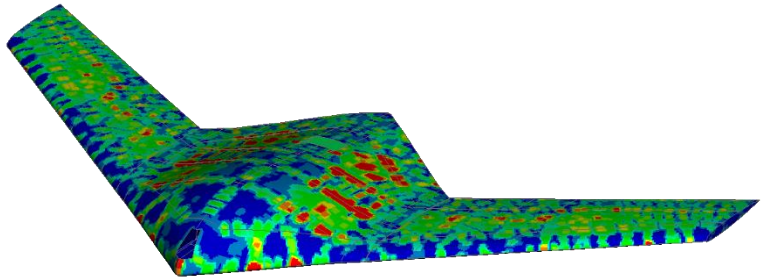
SOL 200 Topology Optimization: Embedded Task Wizard

Defines:

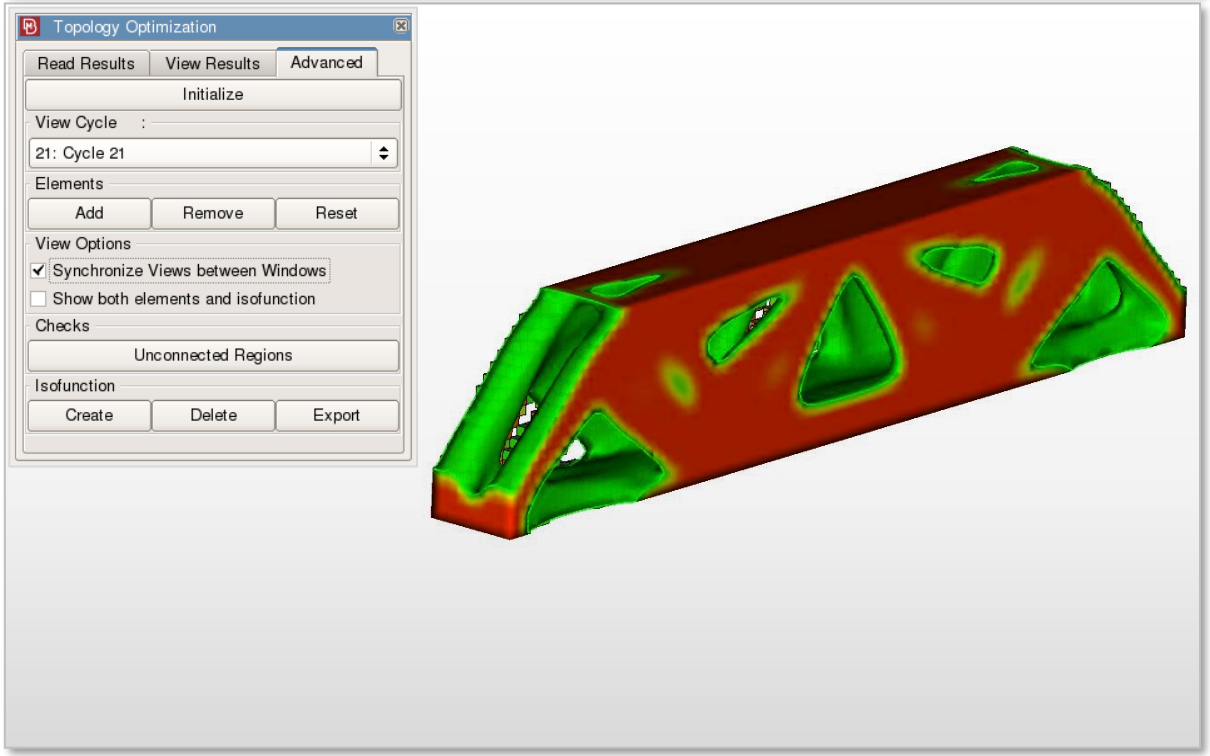
- Call the solver
- Auto complete the Header with multiple subcases

SOL 200 Topometry Optimization





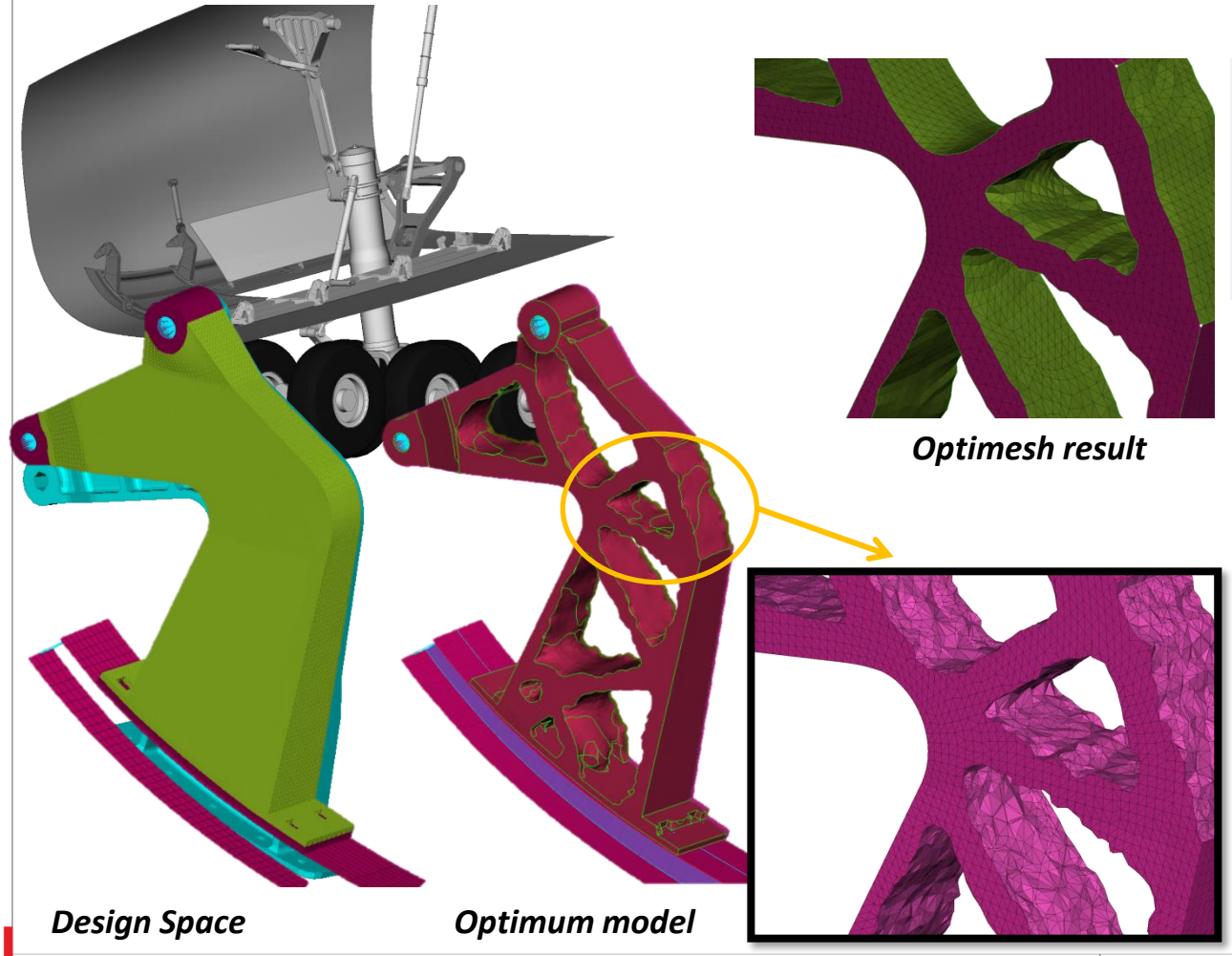
Topology Optimization: META Tool



Post Processing for Optimization

- Auto detect results file (.des)
- Several View Modes
- Creates smoothed surface from the optimized area
- Exports the surface in neutral format

Optimesh:
New tool for Topology Optimization Post-Processing

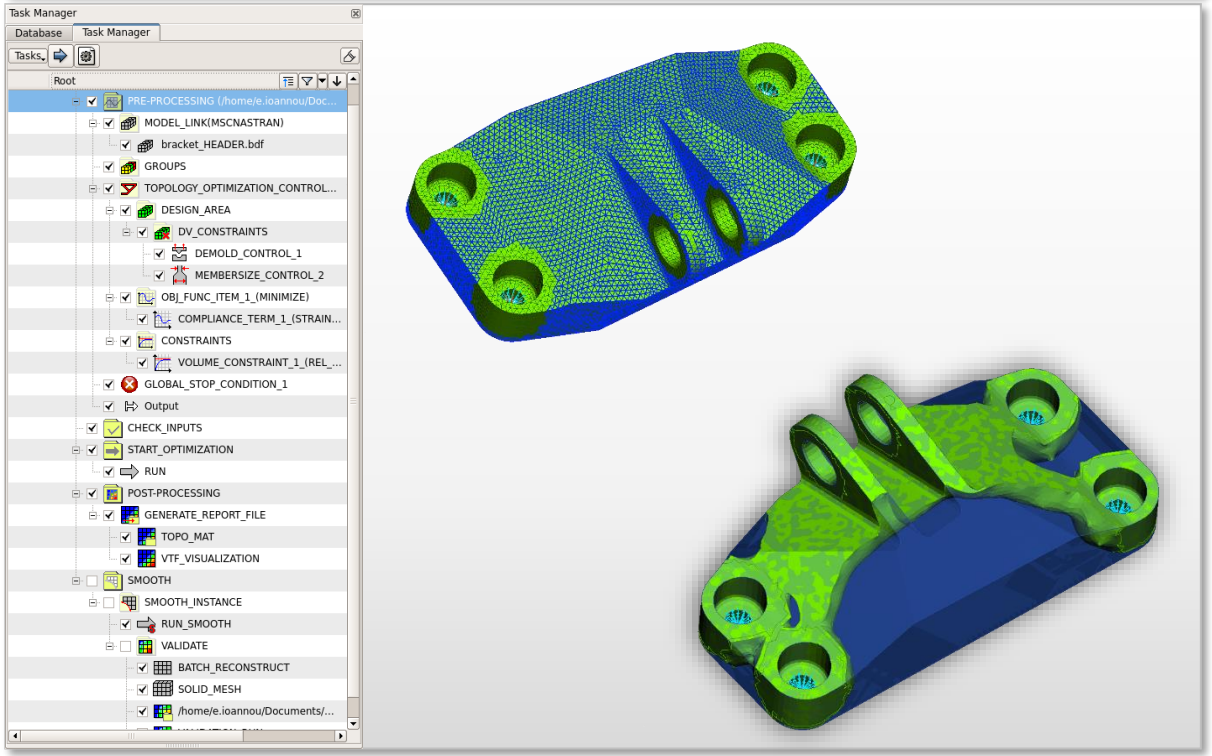


Design Space

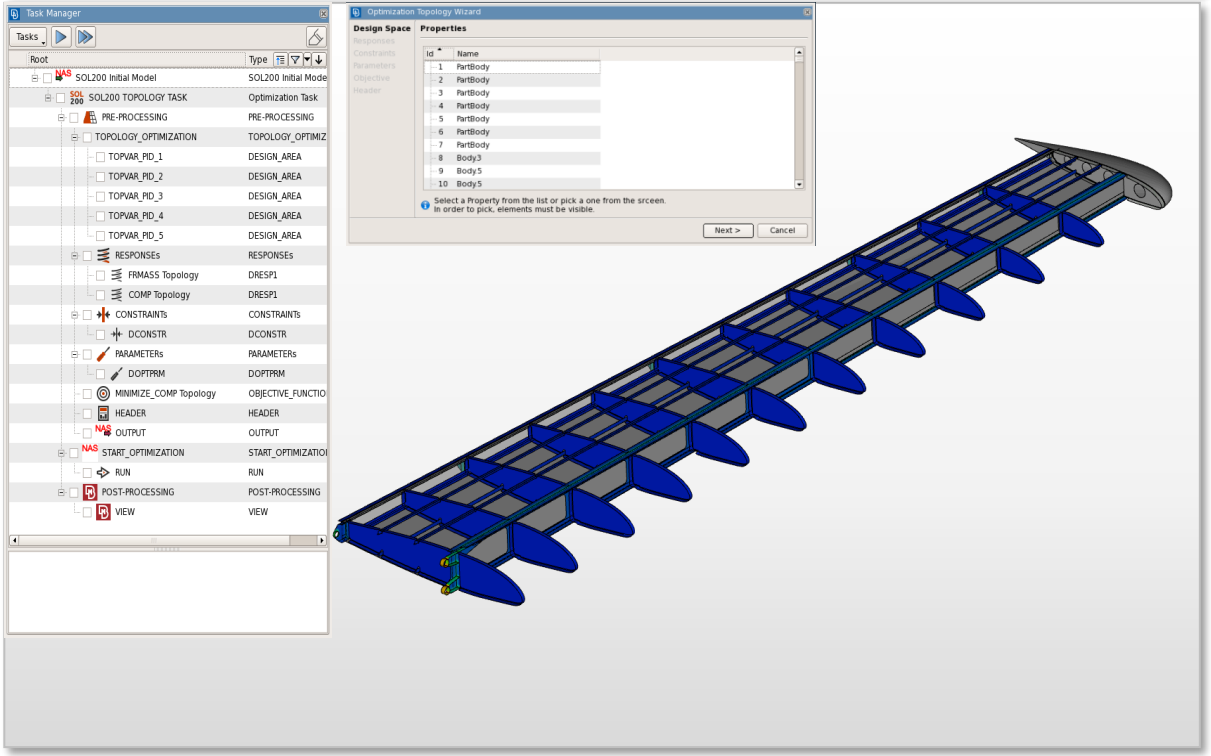
Optimum model

Optimesh result

Topology Optimization: TOSCA

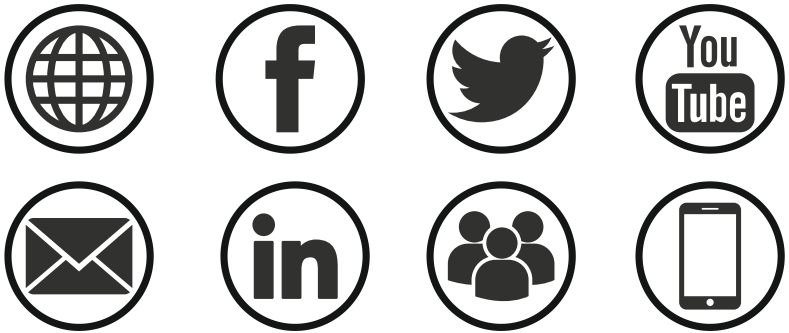


Topology / Size / Topometry



Optimization with EPILYSIS

- Integrated workflow in Task Manager
- Wizard for step by step workflow definition
- Multiple design areas support
- First and second order elements



Stay connected