

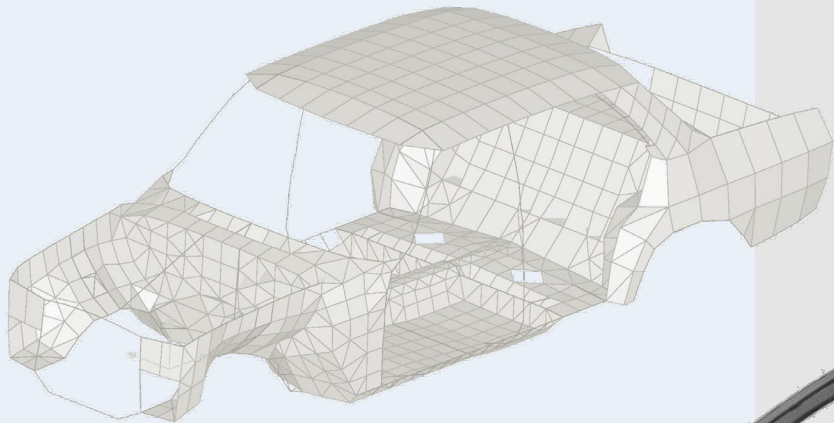
Latest ANSA developments for the creation of LS-DYNA IGA models

Lambros Rorris
BETA CAE Systems International AG

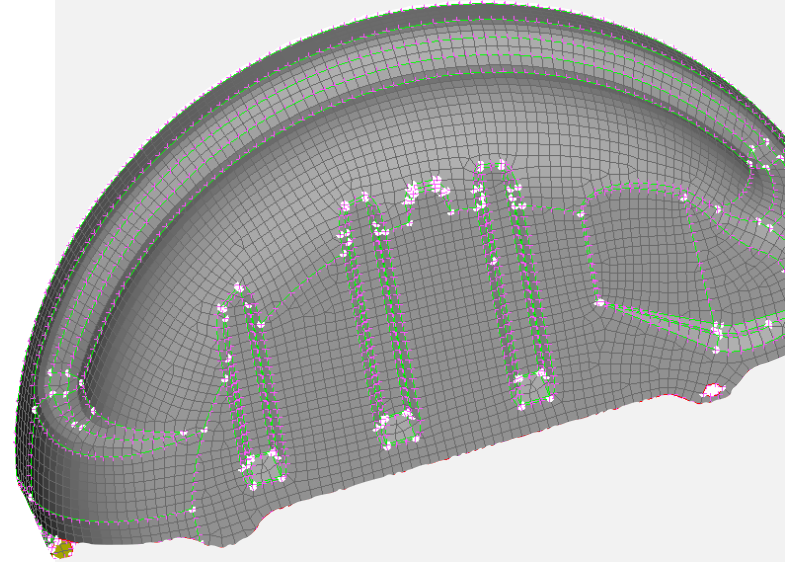
Ioannis Chalkidis
BETA CAE Systems SA

30 years of experience

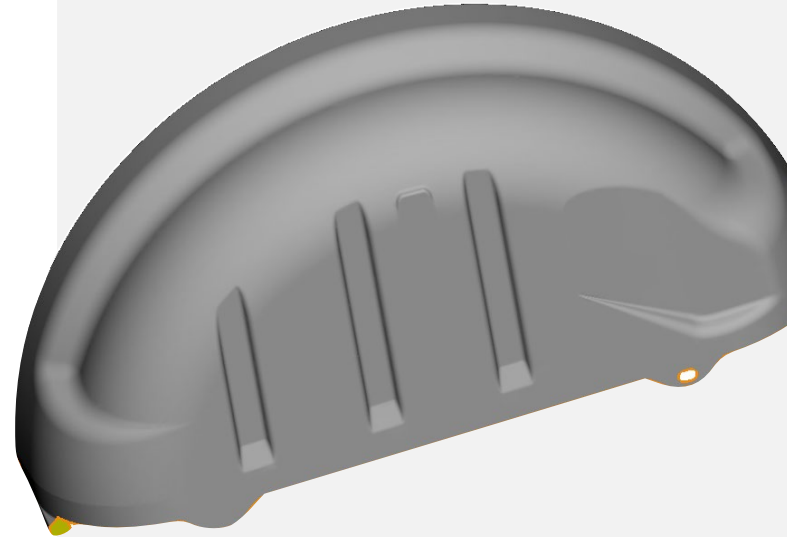
Leader in simulation solutions
> innovative, high performance software
> high quality services

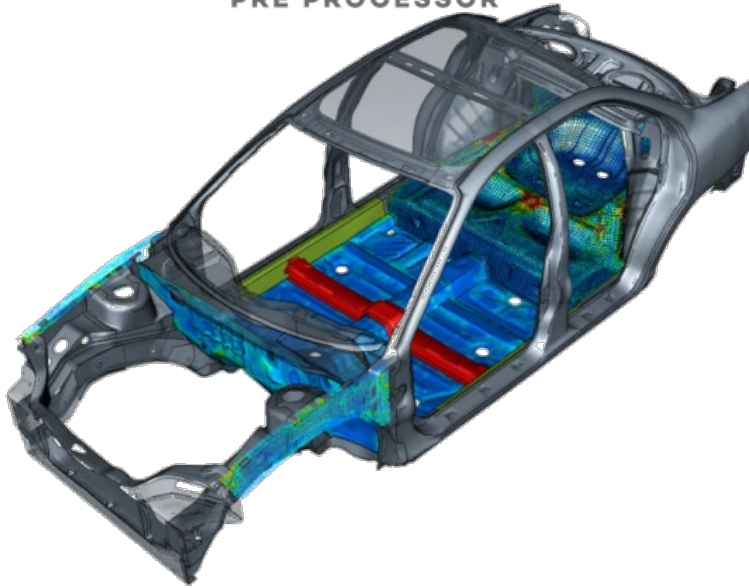


- Different geometry between CAD and Analysis
- Geometric approximation leads to accuracy issues
- Moving between CAD and Analysis is difficult in both ways
 - CAD to Analysis (Meshing)
 - Analysis to CAD

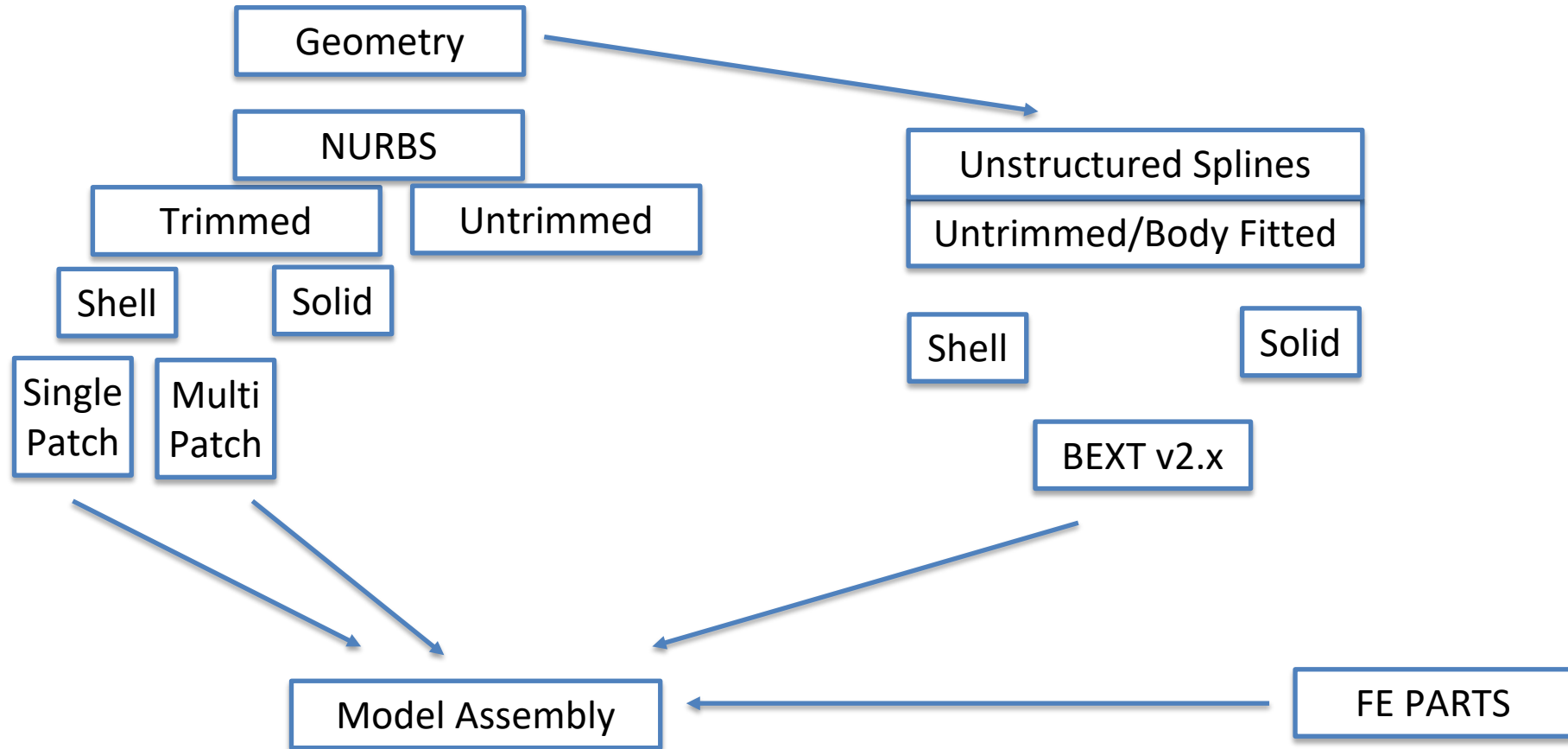


- Use NURBS as basis functions
- Use the same description for the Geometry and Analysis
- Do analysis on the CAD data
- No Meshing

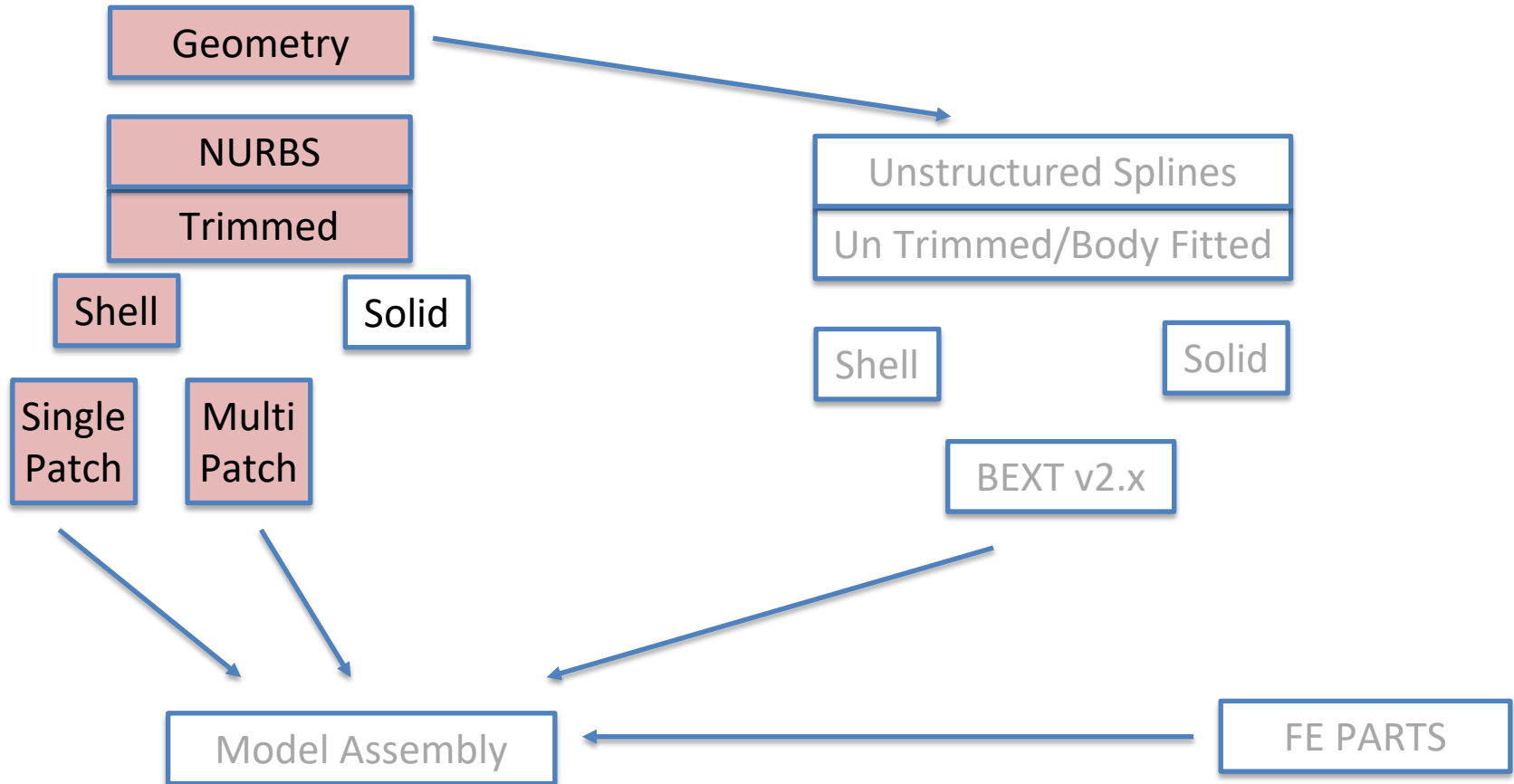




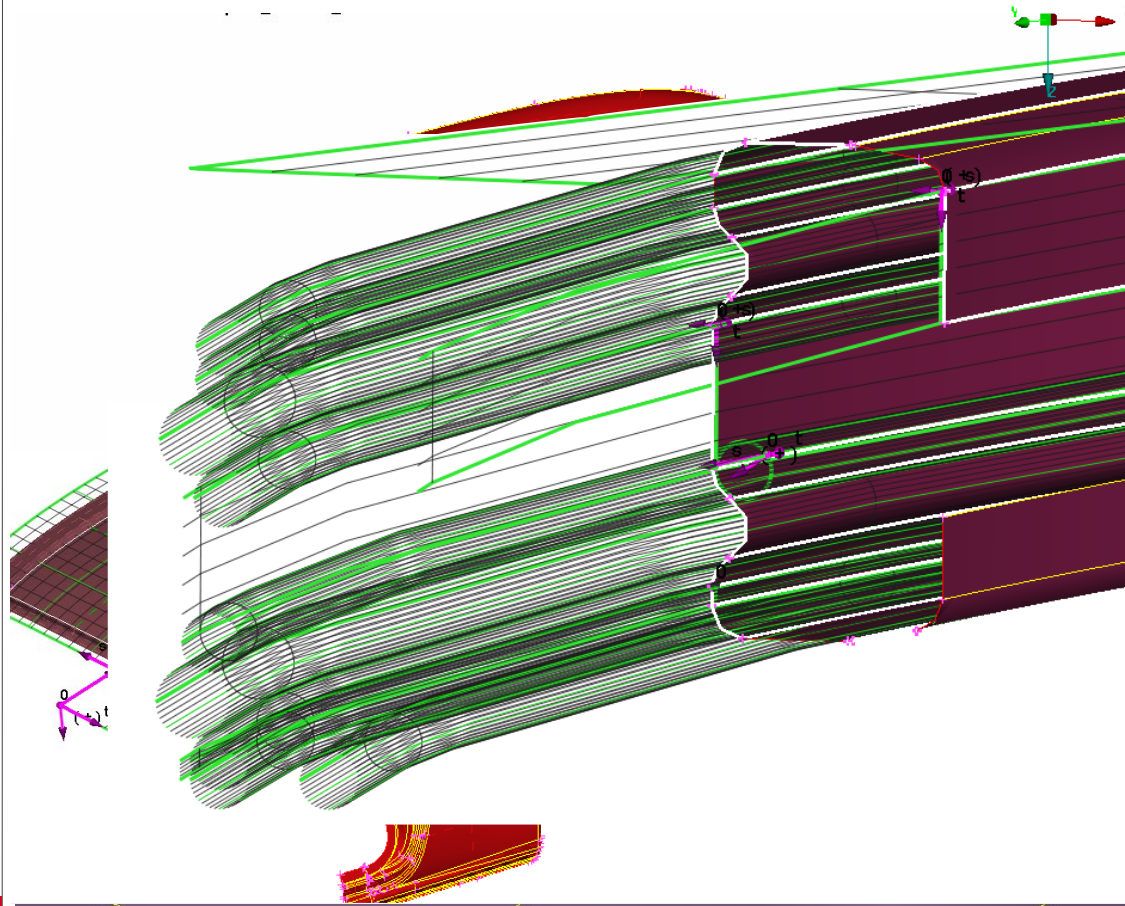
- Only pre-processor to offer IGA Support
- Can operate directly on Geometry
- Our goal is to integrate IGA into current workflows



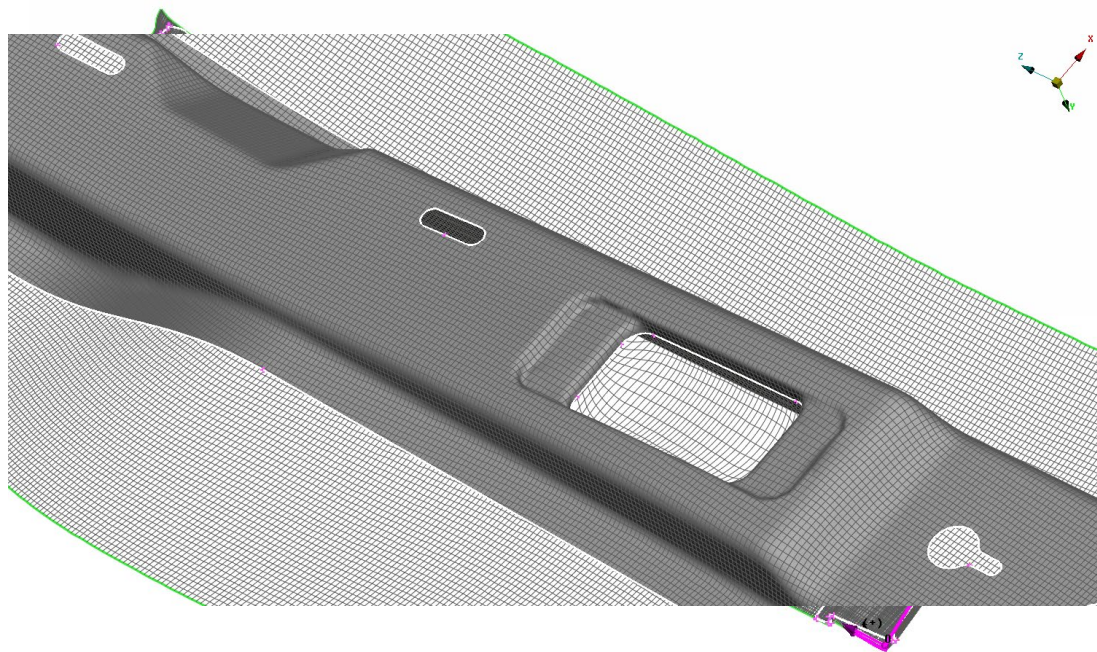
How To Build an IGA model, current mature path



The messy reality of CAD files

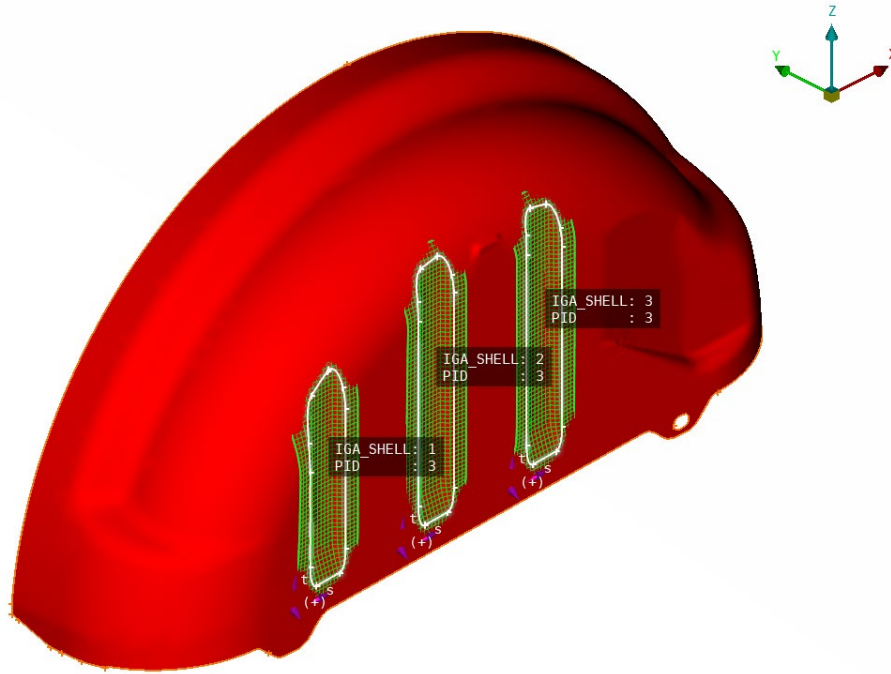


- Solid
- Non - Watertight
- Trimmed
- Analytical Surfaces
 - Planes
 - Cylinders etc
- High order polynomials
- Many Surface Patches per Part



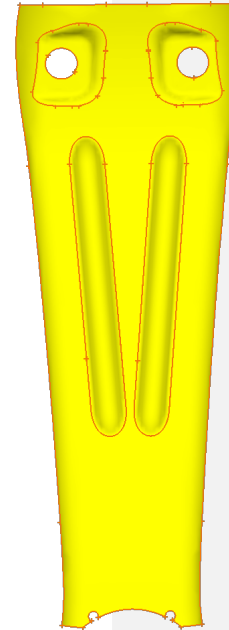
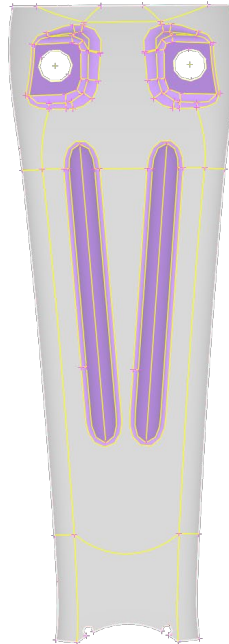
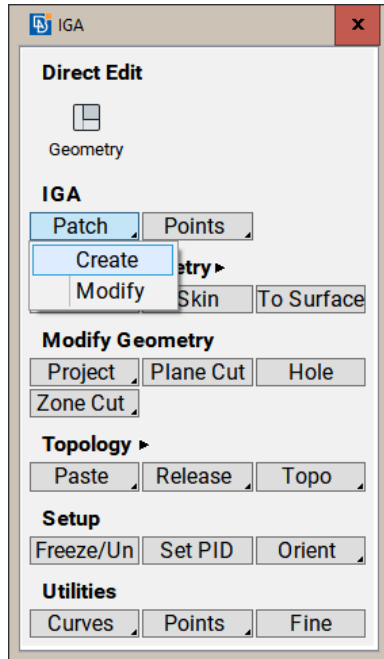
ANSA IGA Creation Function

- From Multi-patched CAD
- To one trimmed surface part representation
- IGA Ready
- Can handle big parts
- With complex features
- Fast
- More tolerant to bad geometry



- Creation of complex parts with one click operation
- Creation of multi-patched IGA parts, semi-automatic

From Feature Manager to Multi Patch IGA

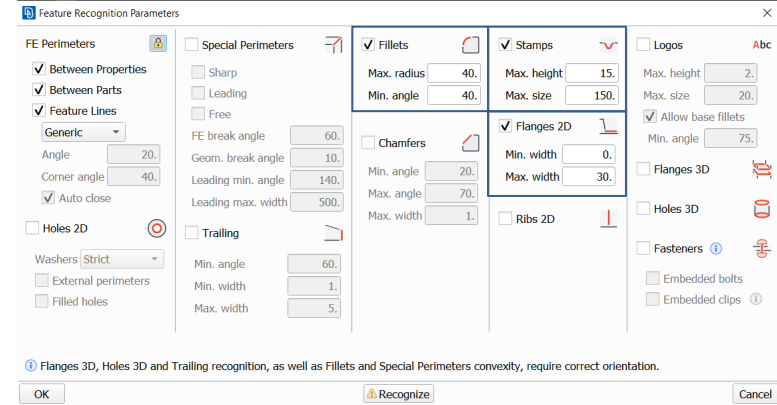
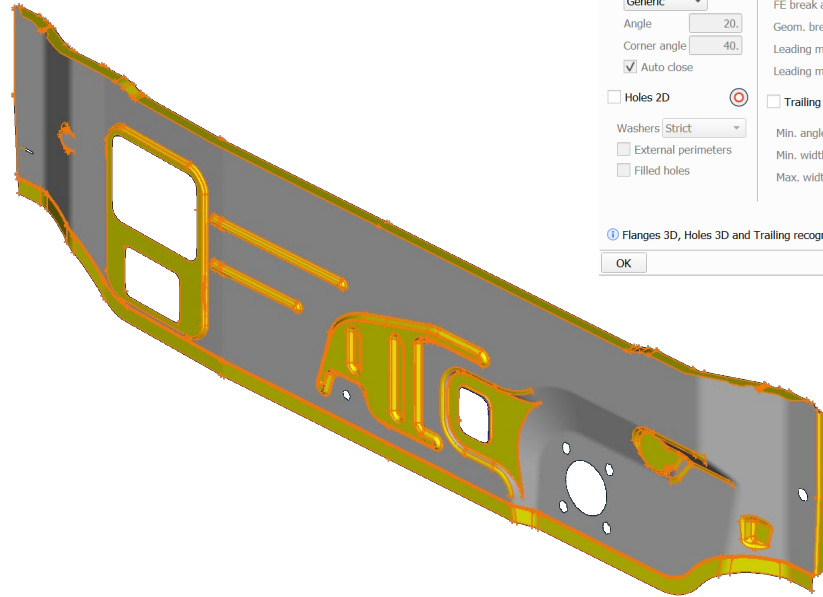
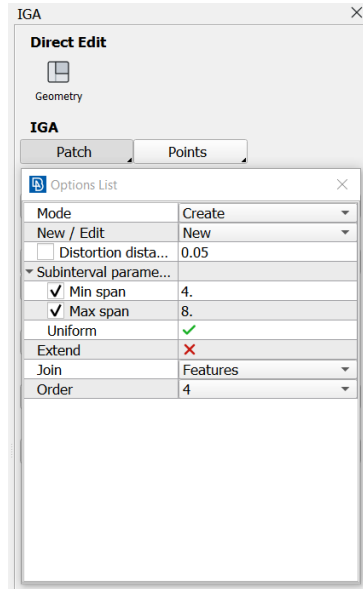


Options List	
Mode	Create
New / Edit	New
☐ Distortion distance	0.05
Subinterval parameters	
☒ Min span	2.
☐ Max span	20.
Uniform	×
Extend	×
Join	Features
Order	4

Multi – Patch Strategies

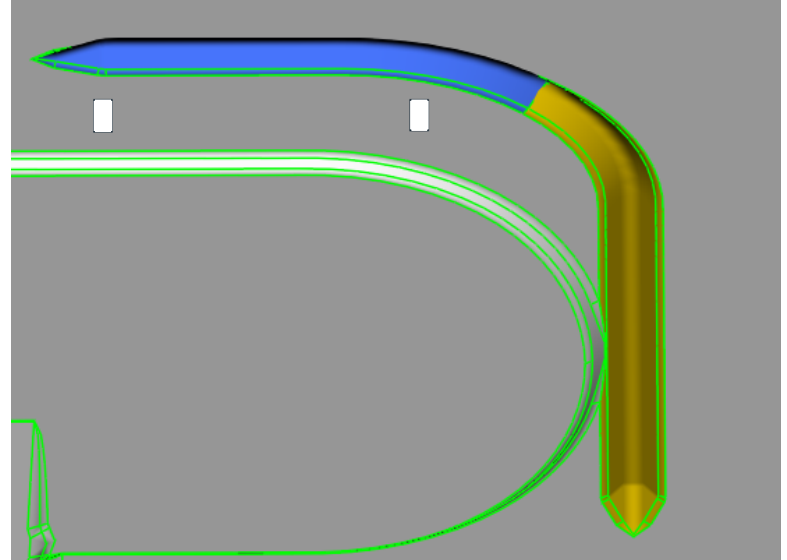
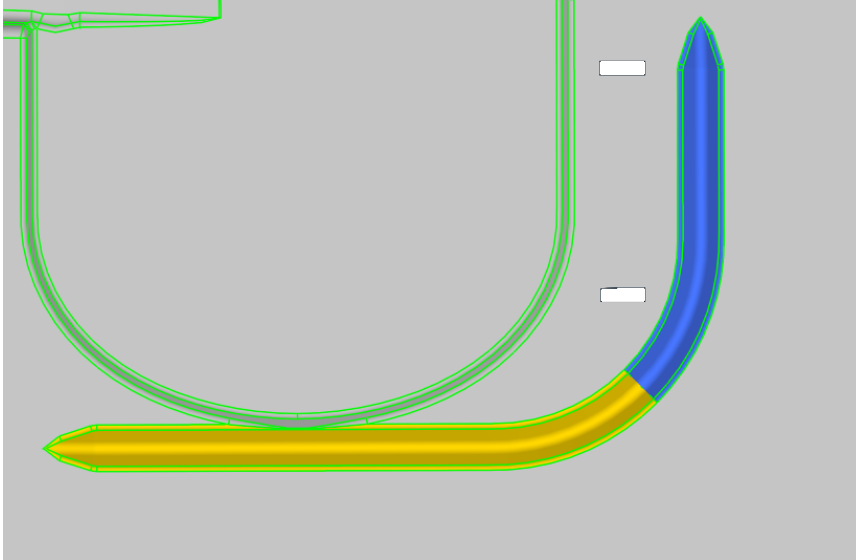
Geometrical Features

Stamps/Flanges 2D/Filletlets



Multi – Patch Strategies Geometrical Features

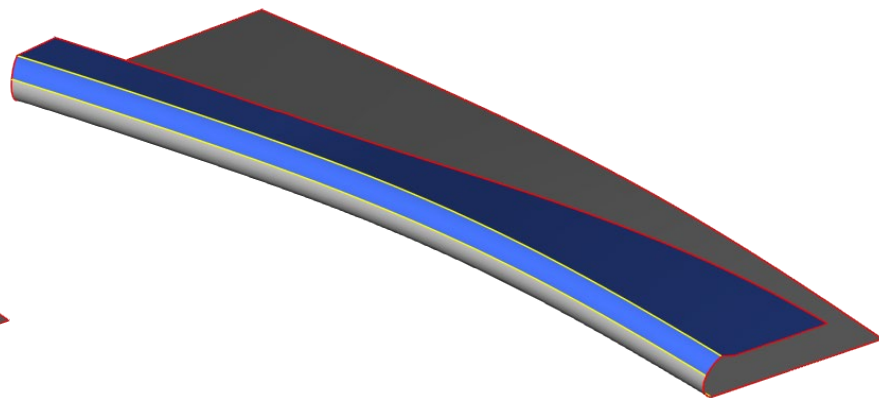
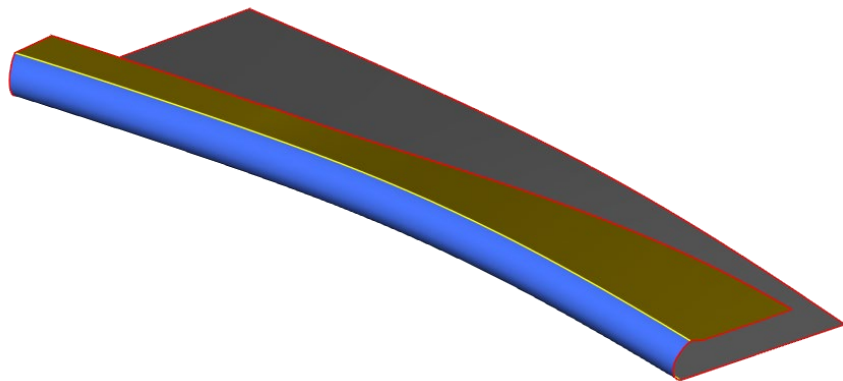
Long fillets



Multi – Patch Strategies

Advanced Cuts

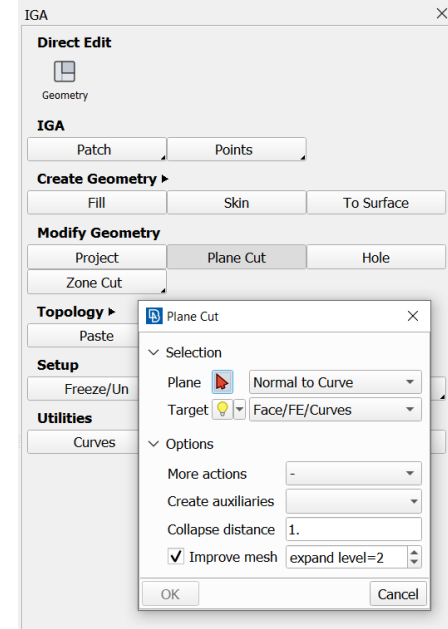
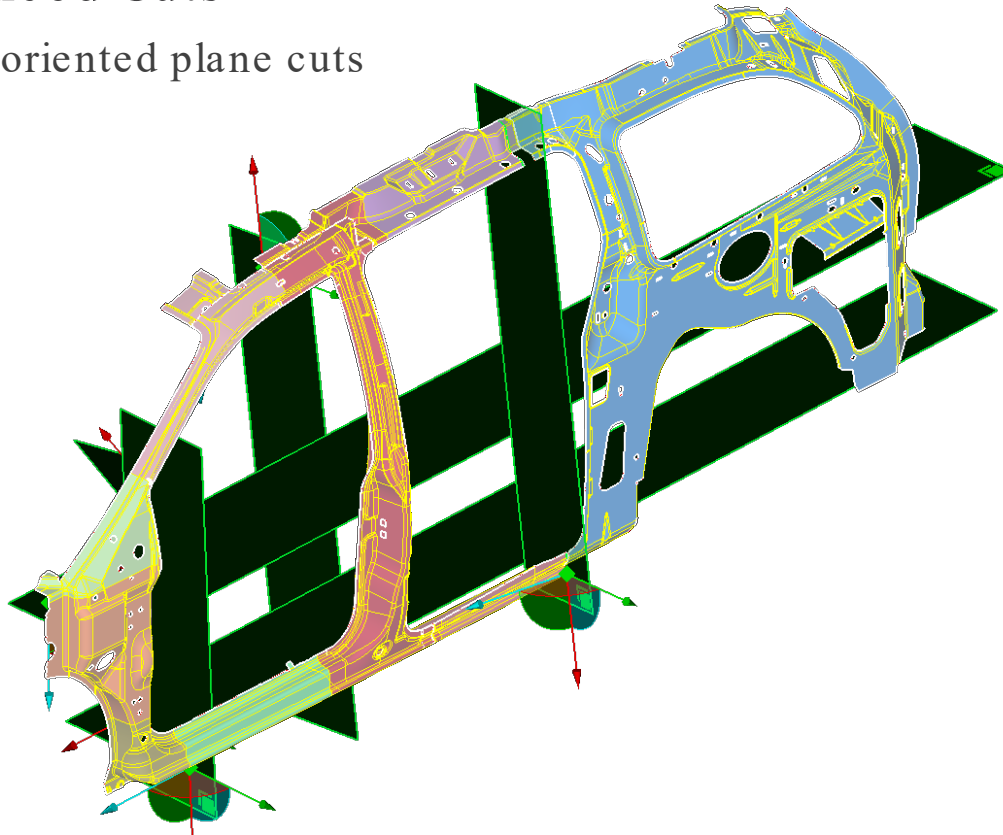
Hemmings



Multi – Patch Strategies

Advanced Cuts

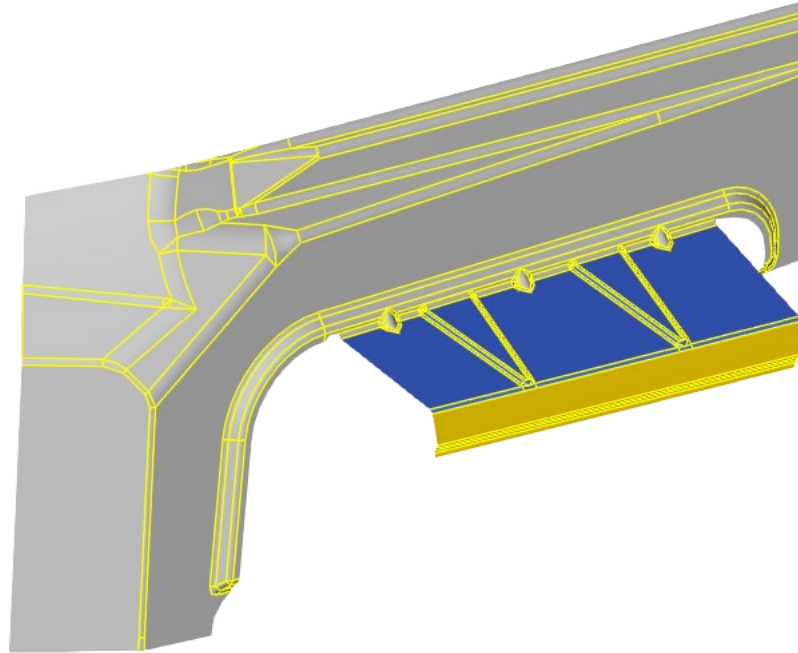
Object oriented plane cuts



Multi – Patch Strategies

Multiple Bendings

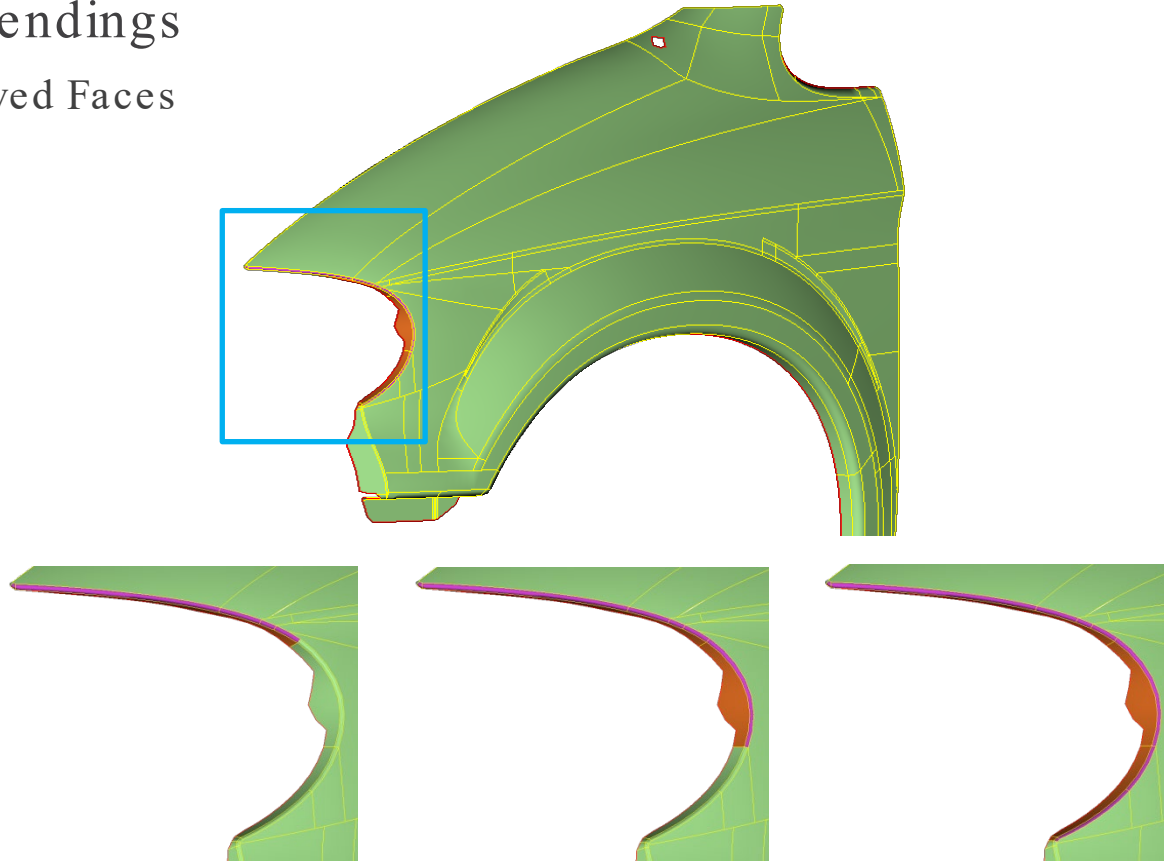
Multiple Bendings



Multi – Patch Strategies

Multiple Bendings

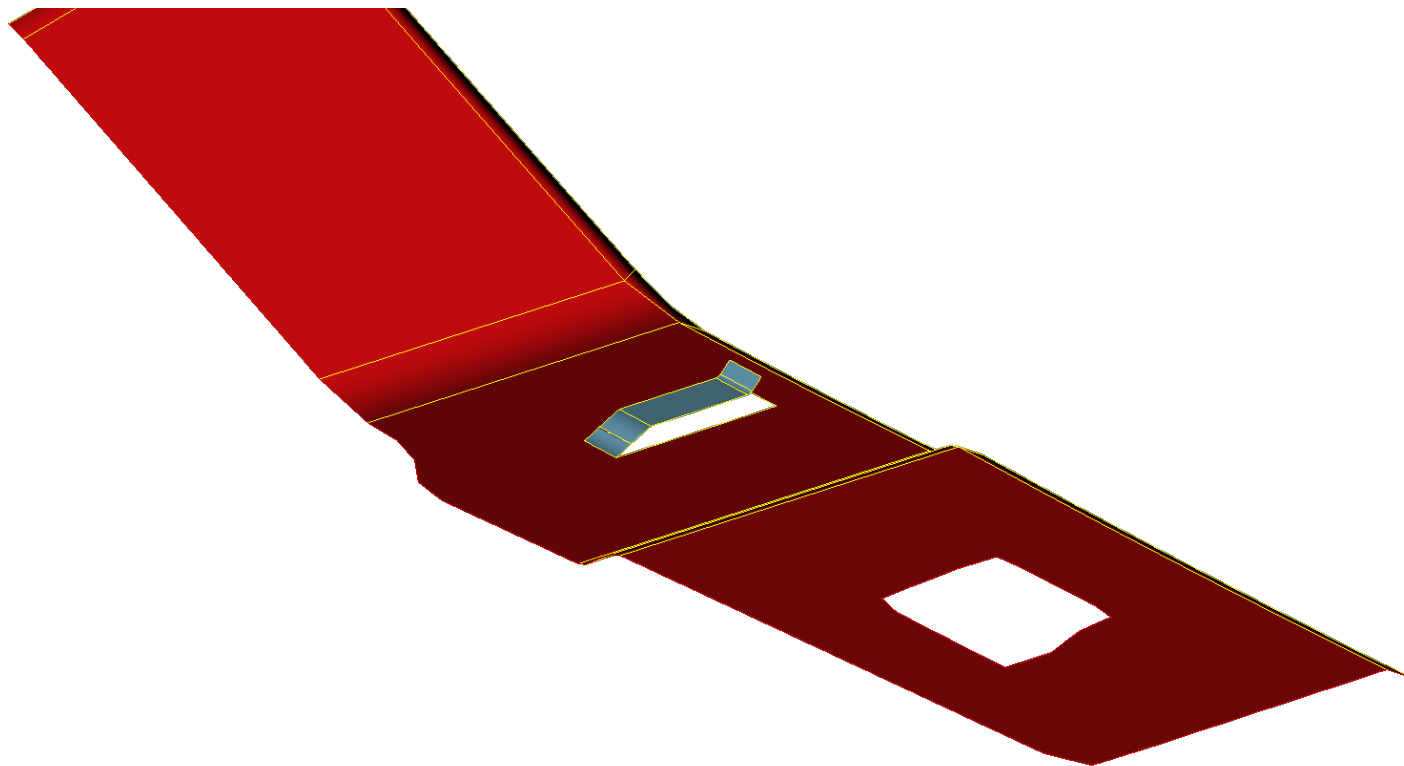
Multiple Curved Faces



Multi – Patch Strategies

Multiple Bendings

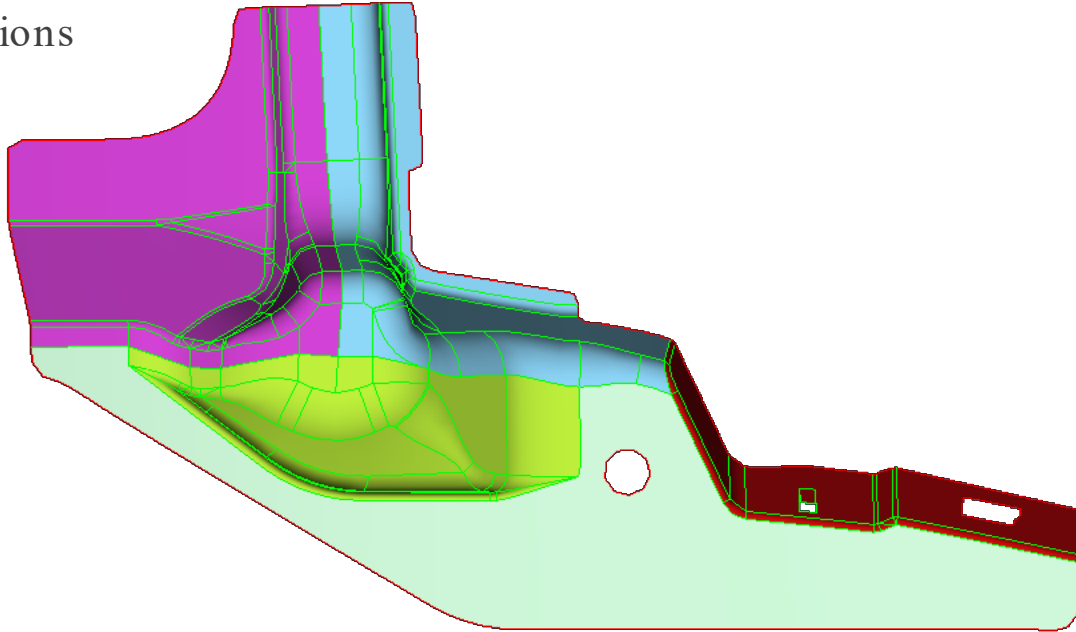
Clips



Multi – Patch Strategies

Multiple Bendings

Complex Protrusions





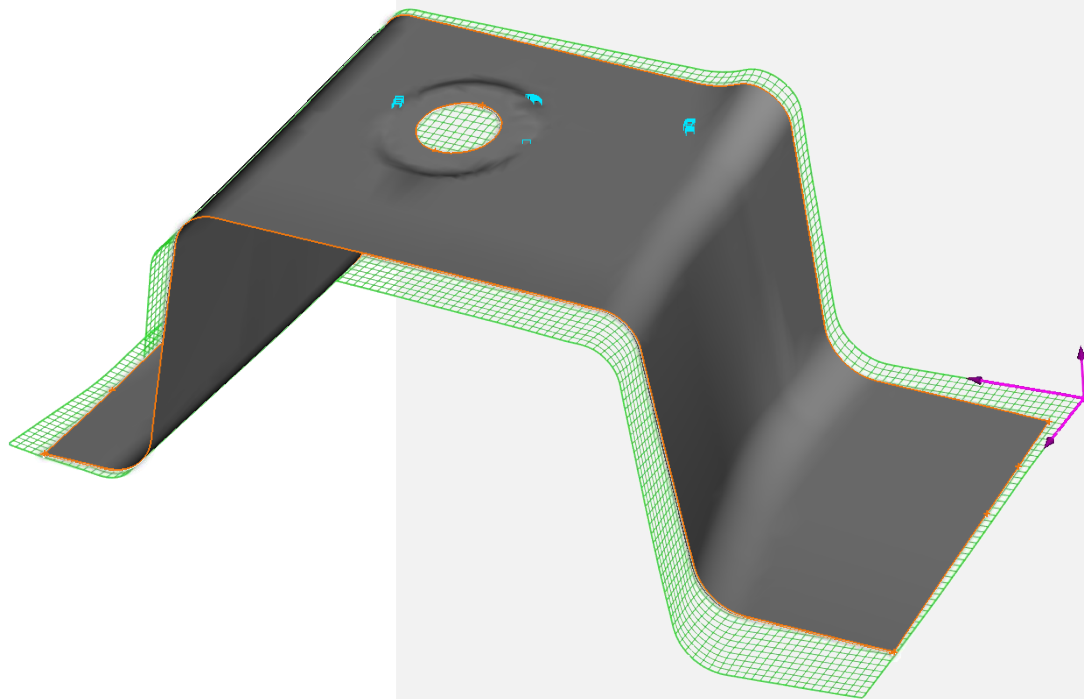
IGA_SHELL: 1

B-Spline surface [162 x 54], order (4 , 4)

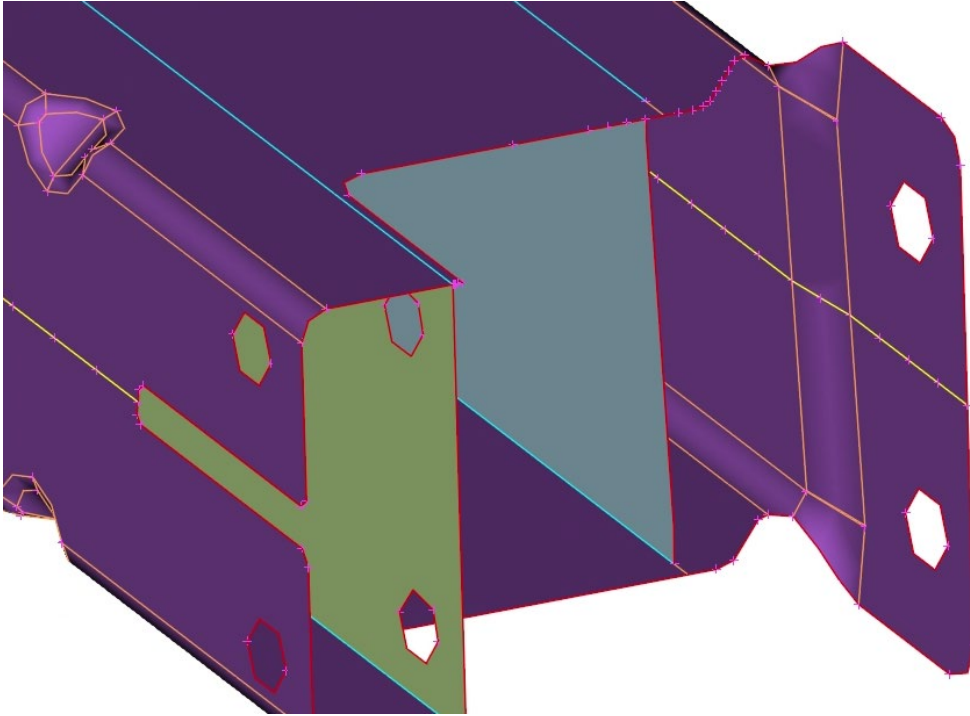
	Minimum	Average	Maximum
S-span :	0.5133	2.1342	3.8511
T-span :	1.1931	2.1743	3.5366

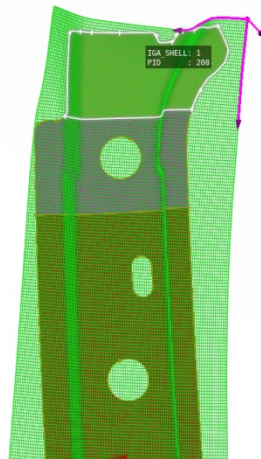
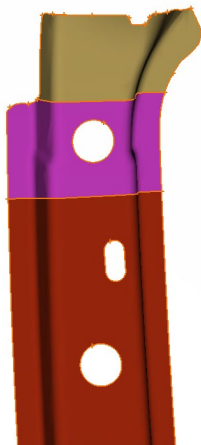
Negative Jacobian areas :

2569.910510, 887.439579, 974.200864
 2569.170565, 887.482502, 973.573627
 2571.159950, 887.356148, 975.360319

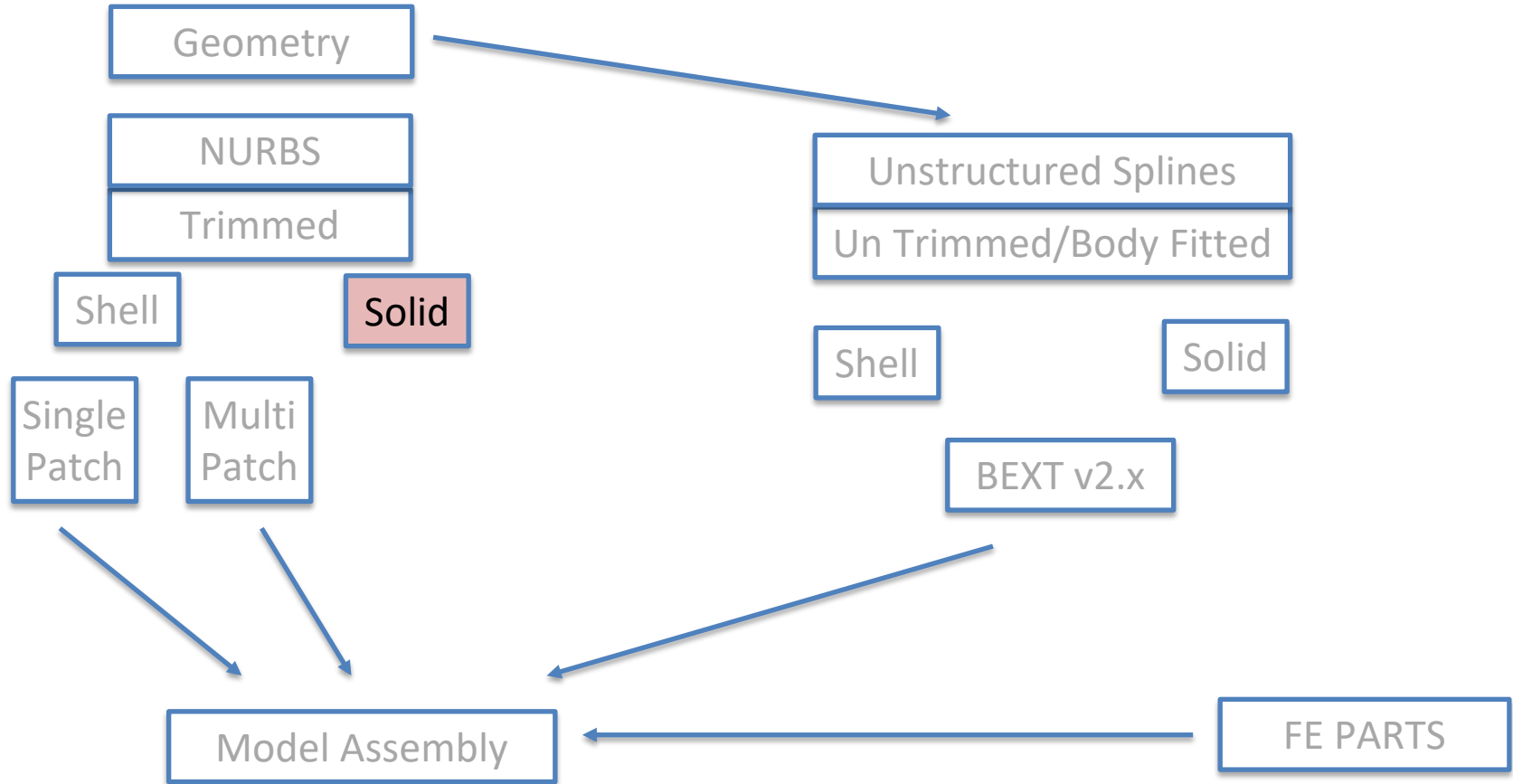


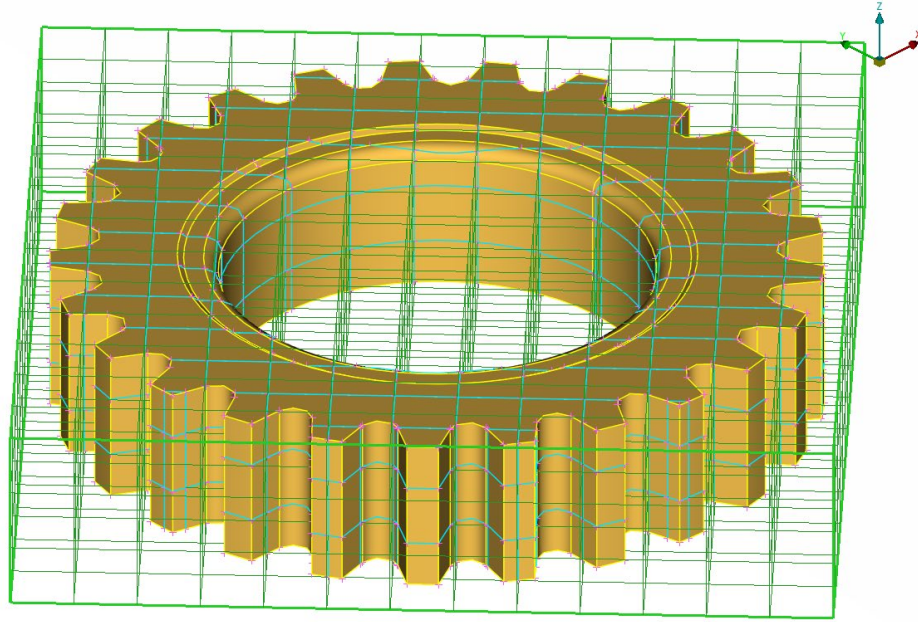
- T-Junctions
 - Triple Bounds are possible



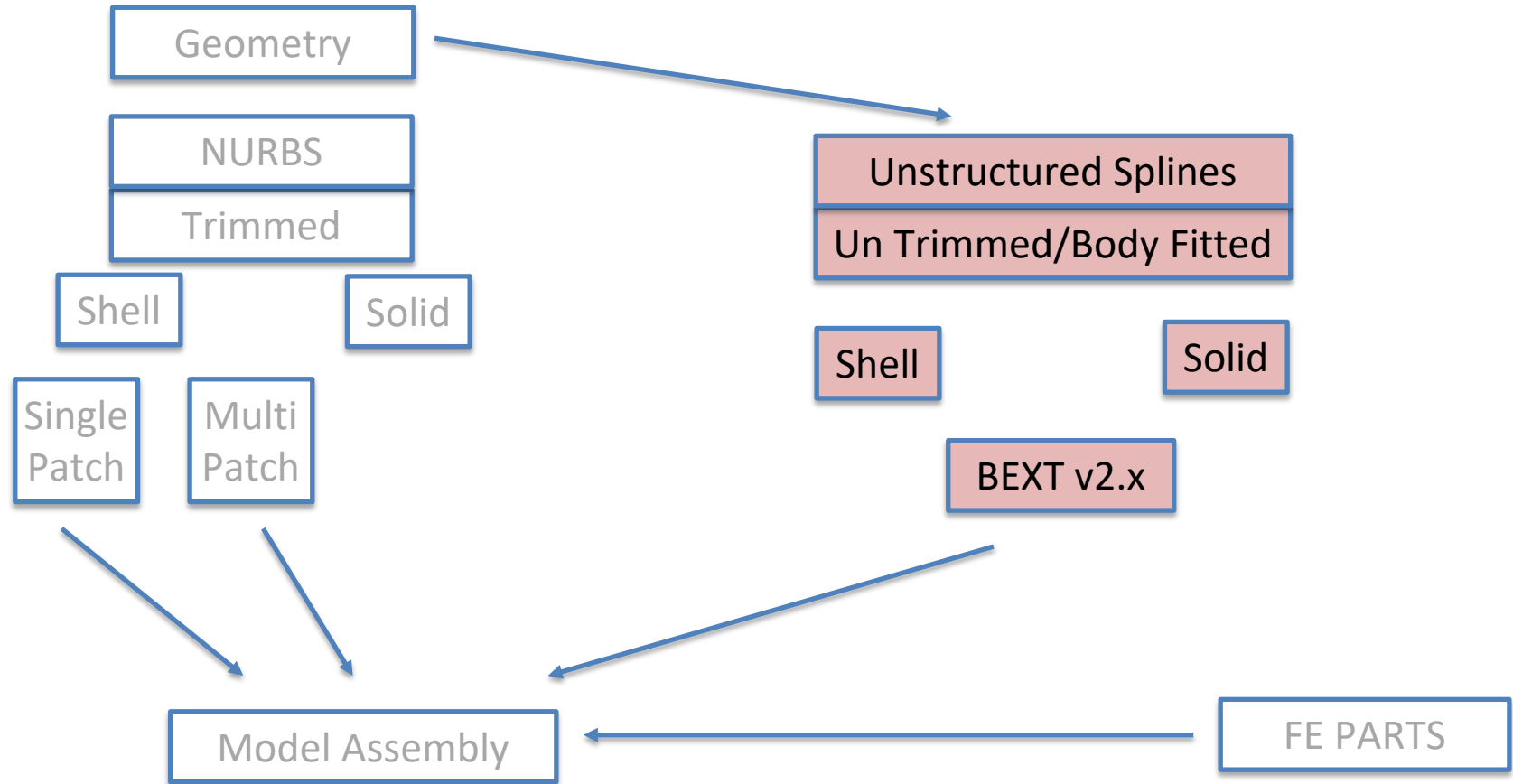


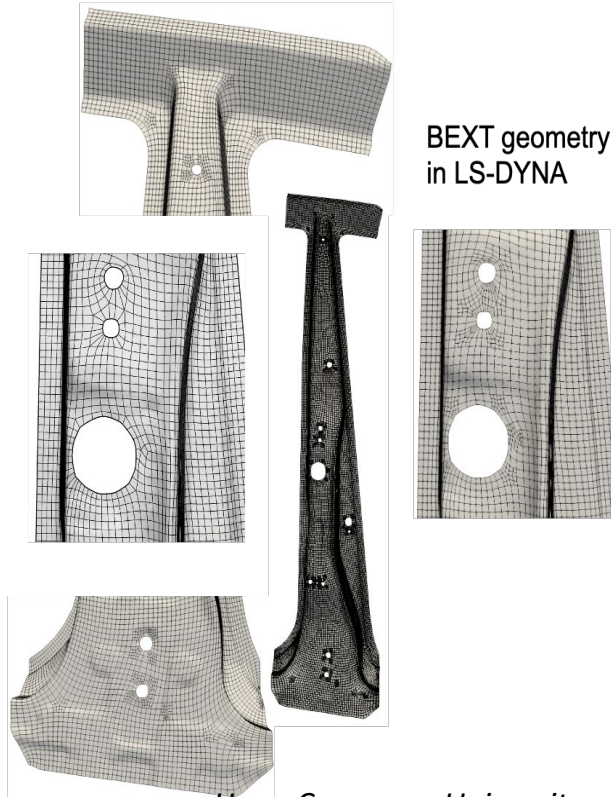
- Support of Multiple Patches residing on the same surface





- Support of Trimmed and Untrimmed solids for pre-processing (3d-NURBS)
- Creation of Trimmed solid descriptions





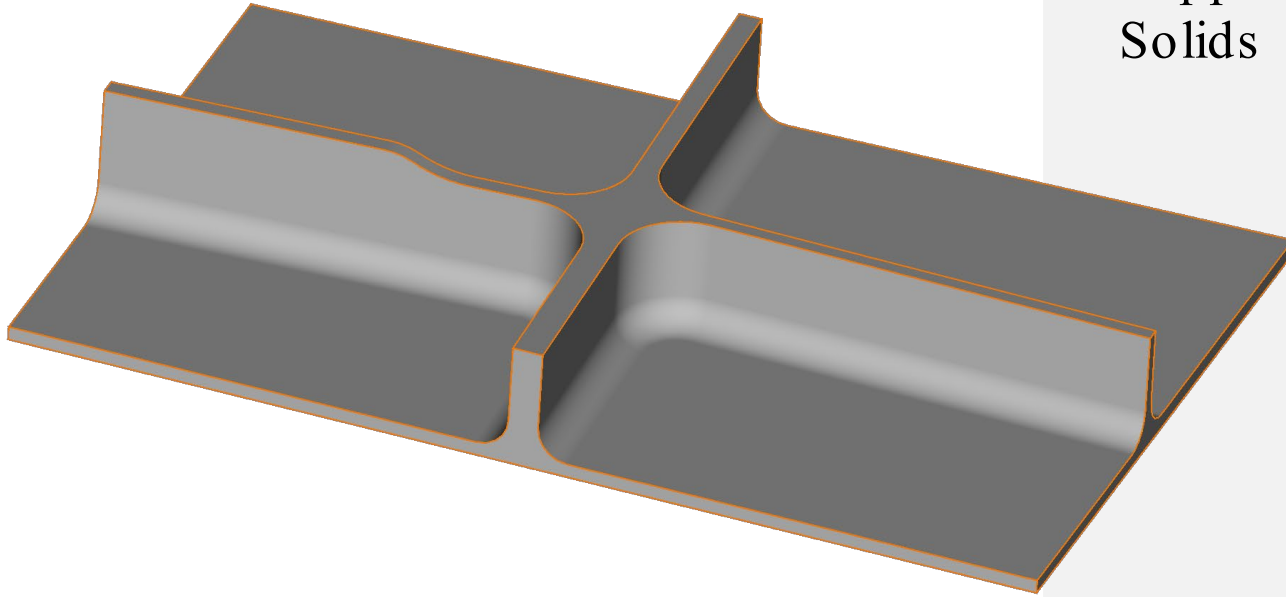
BEXT geometry
in LS-DYNA



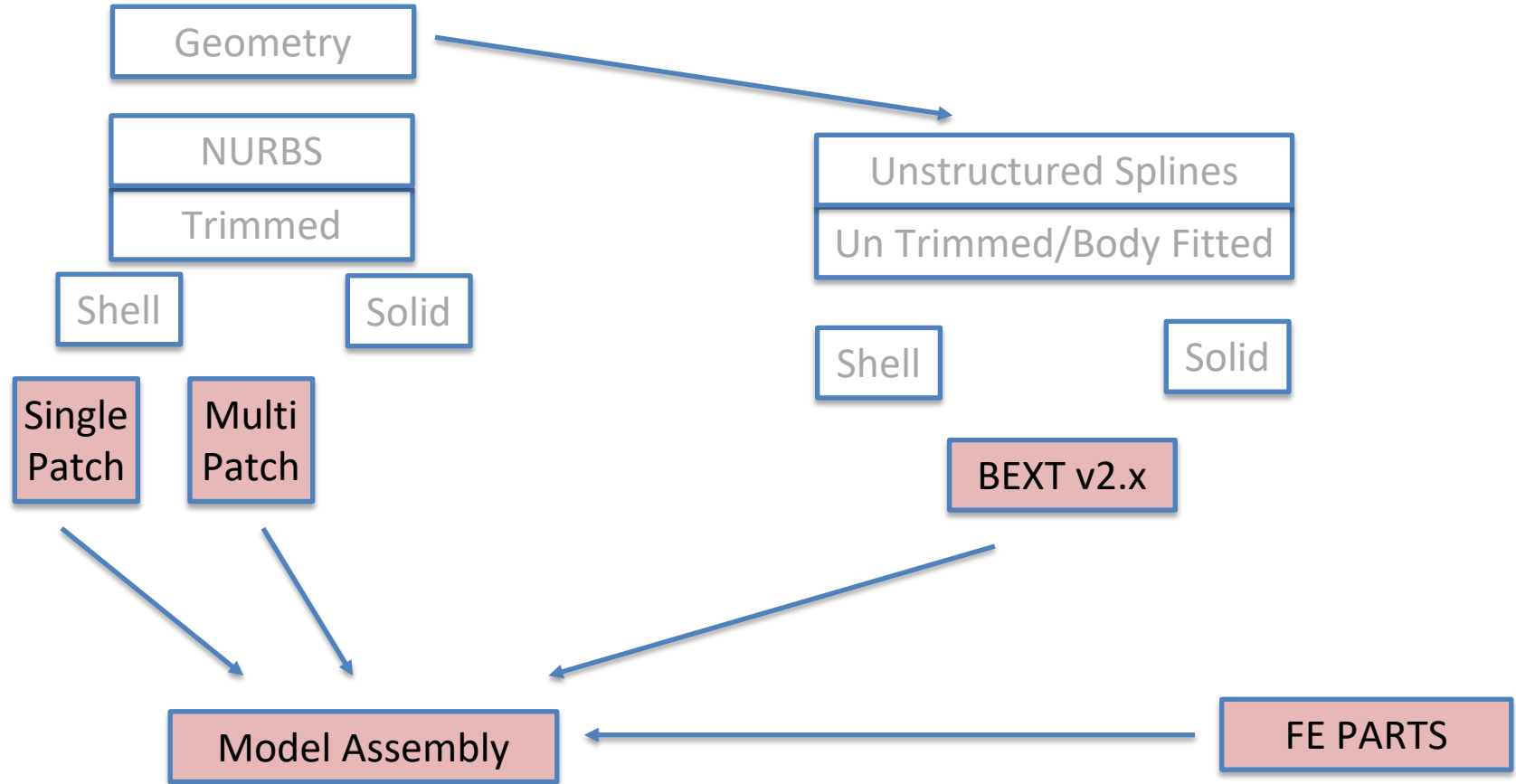
- Support of other spline technologies through BEXT

Hugo Casquero, University of Michigan

- Support BEXT for Solids

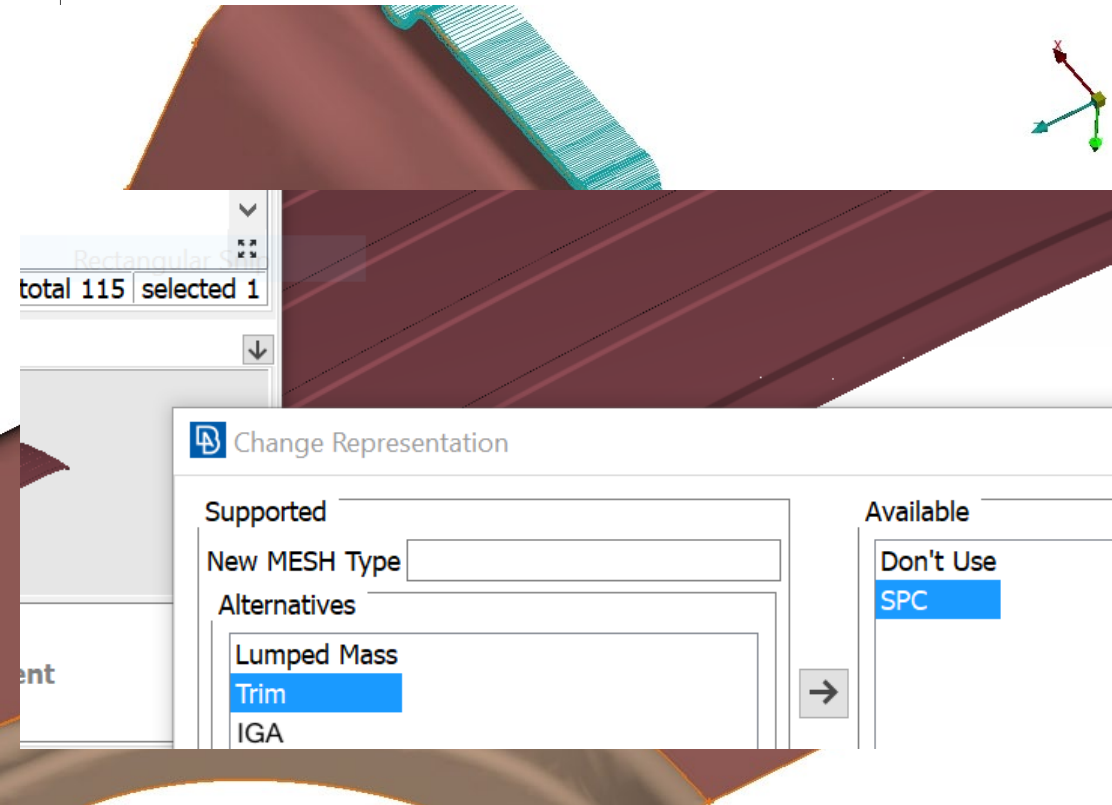


How to Build an IGA model, Bring everything together

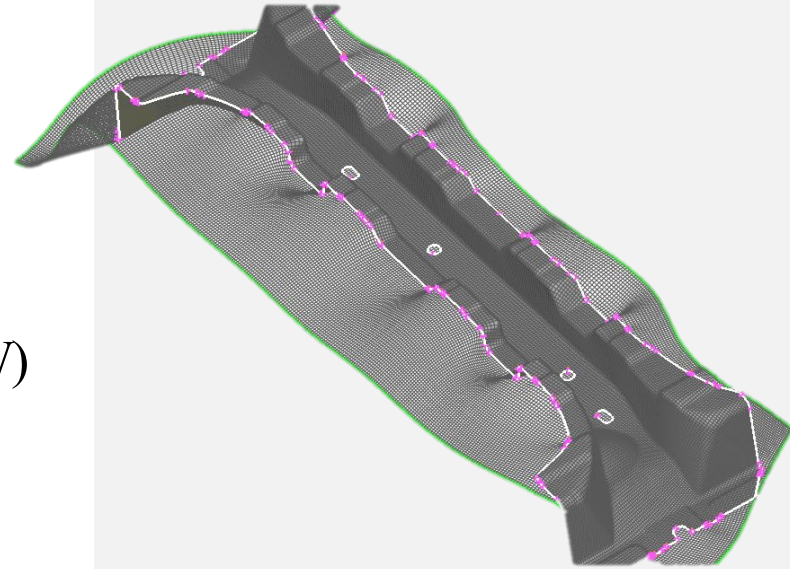


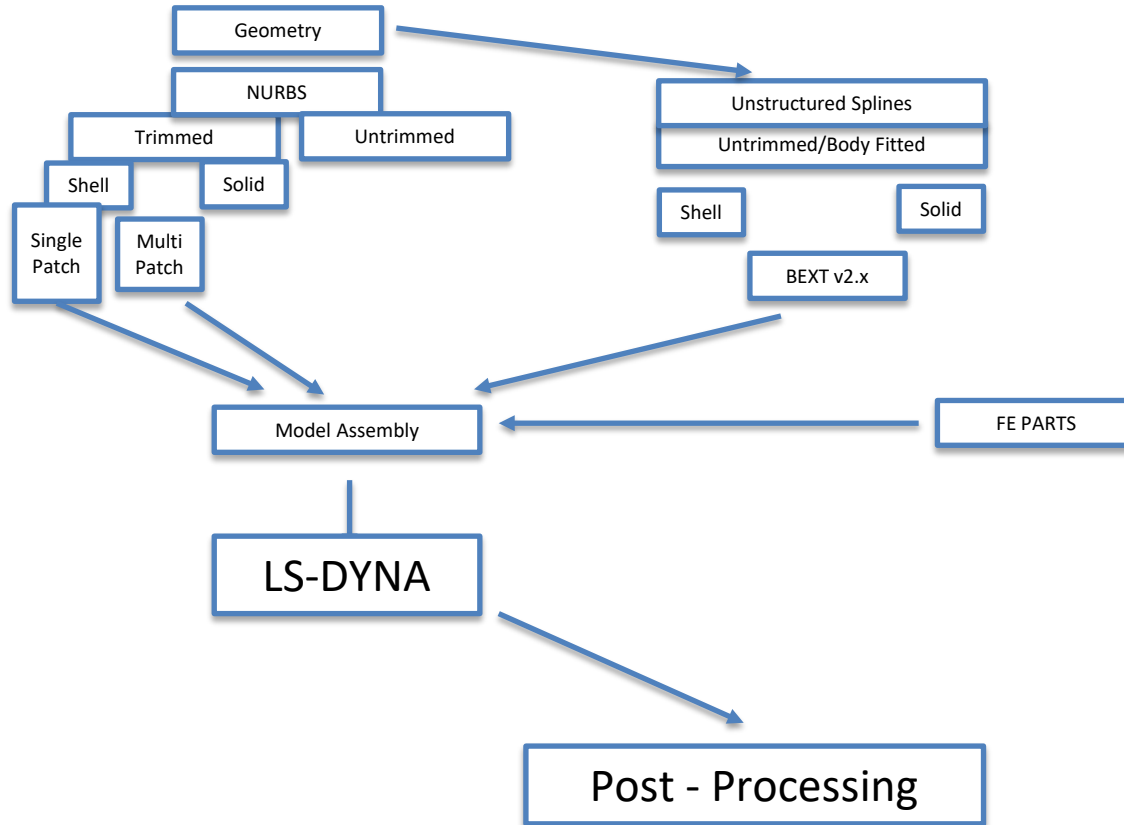
Current IGA Status - Assembly

- * IGA_POINT_UVW
- Multi projection of nodes to patches
- Spotwelding
- Assembly
- BCs on Geometric Entities
- Parts Management



- Single/Multi Patch IGA Ready Geometry Creation
- *IGA Keywords Supported
- BEXT Shells and Solids Supported
- Assembly either though Mesh Independent
- Or Mesh Dependent (*IGA_POINT_UVW)
- Application of Boundary conditions
- Most ANSA tools IGA aware
- IGA Conversion to CAD



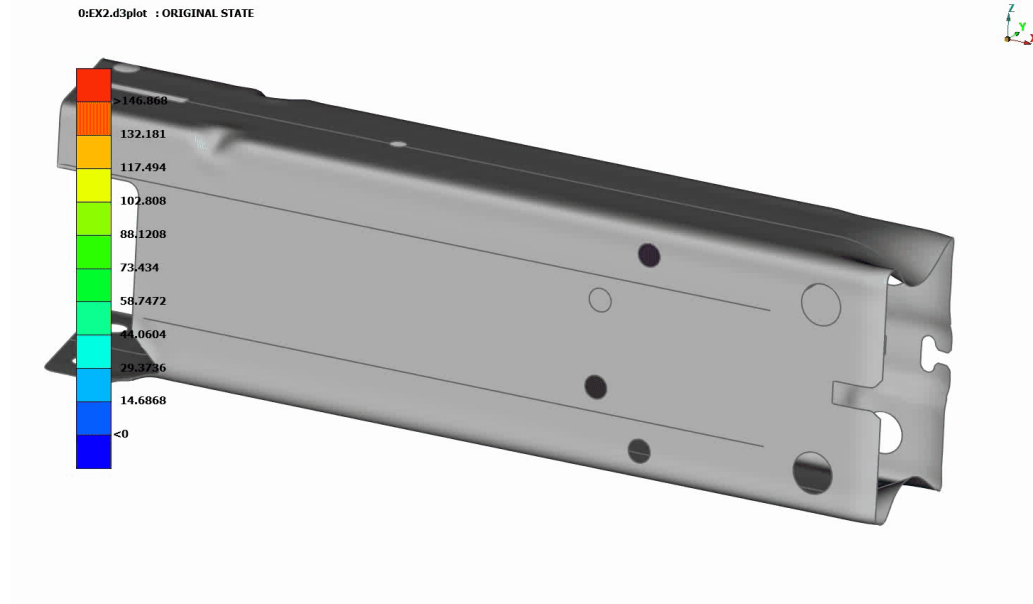


META

POST PROCESSOR



- Native Support for IGA results
- Directly on IGA Surface
- Fast
- Precise



Courtesy of BMW Group



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