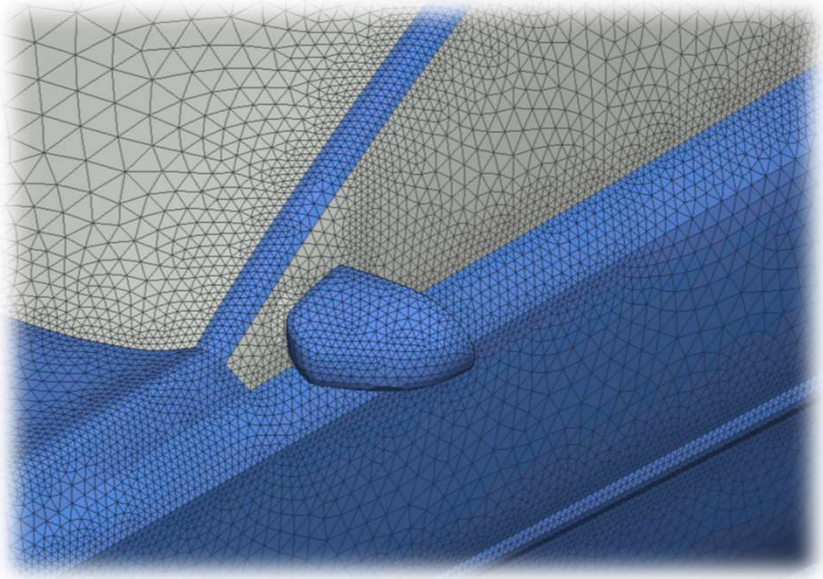
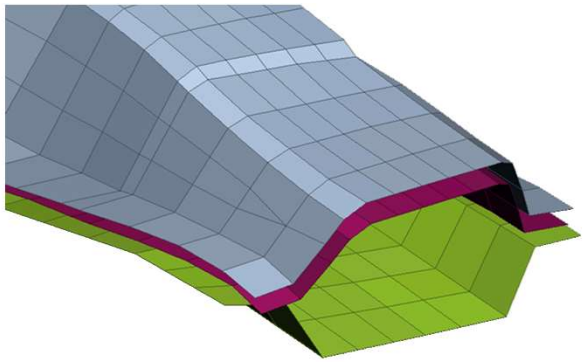
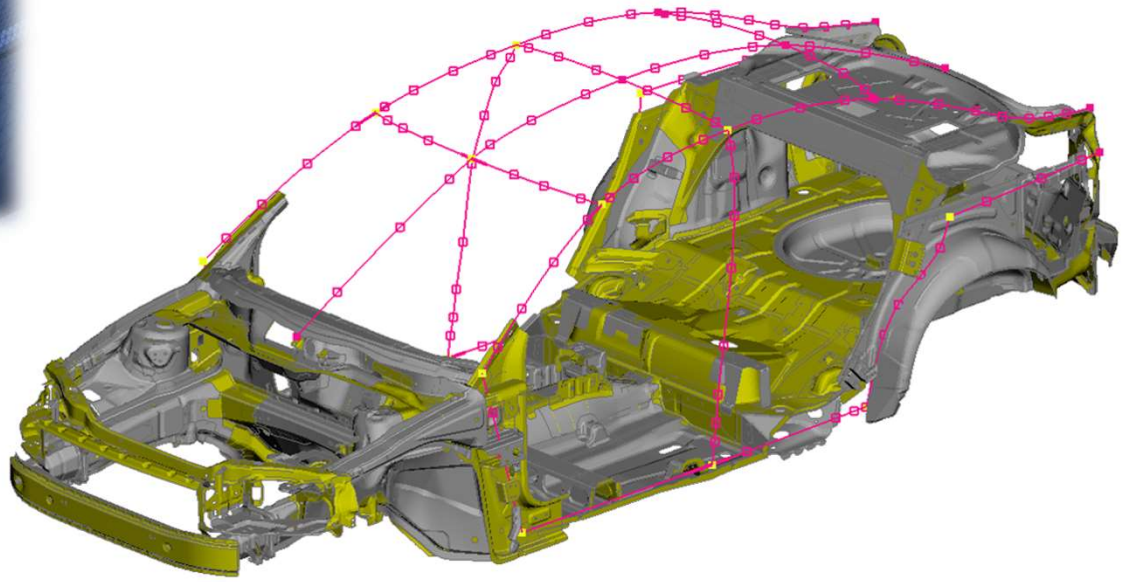
Model Parameterization in ANSA



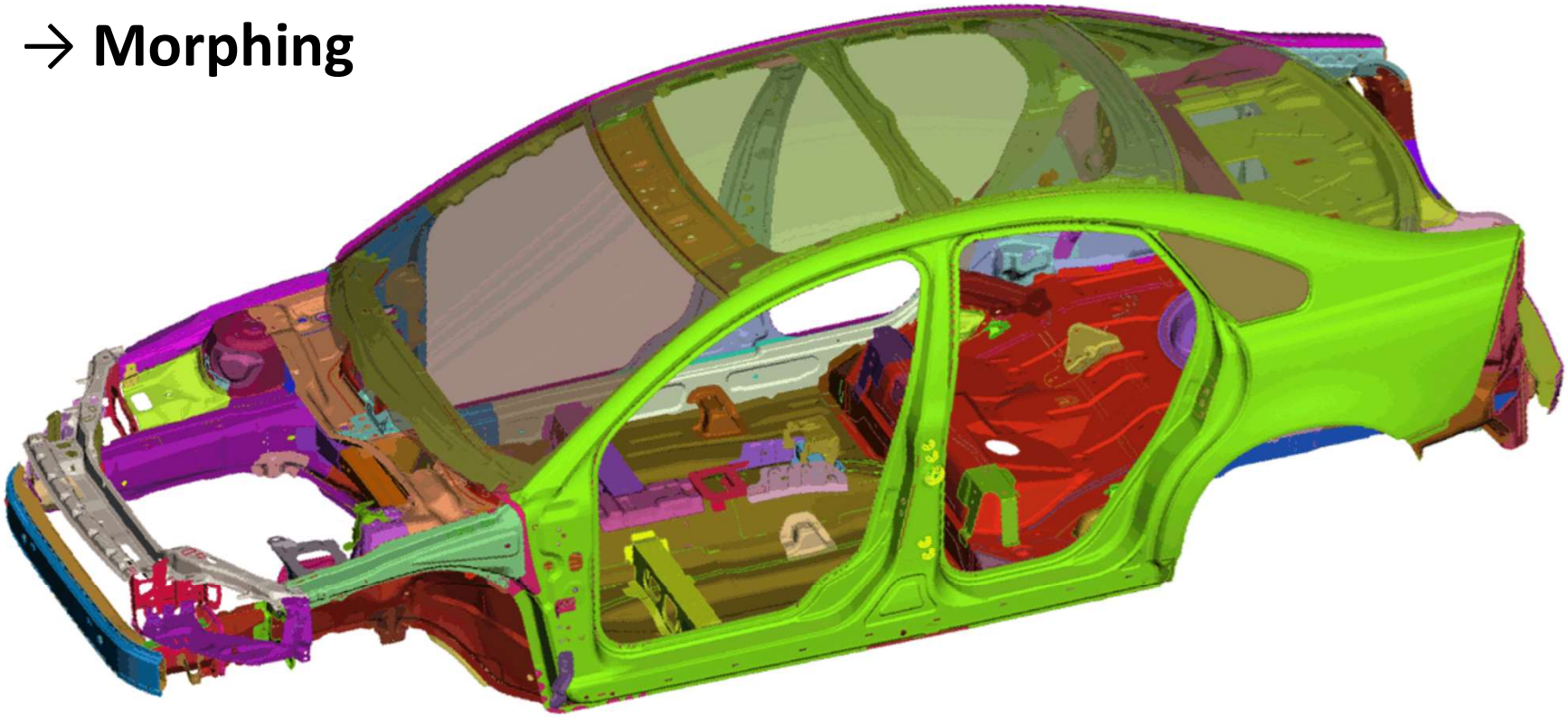




Dirk Dreißig
Mail: ansa@lasso.de

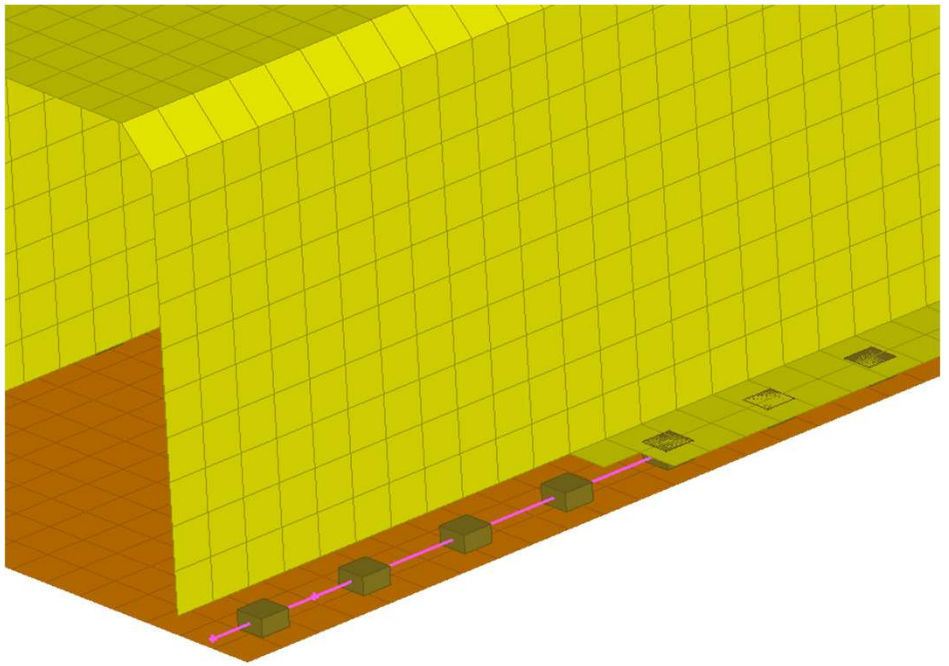
Types of Parameterization

- Shape modification
  → **Morphing**



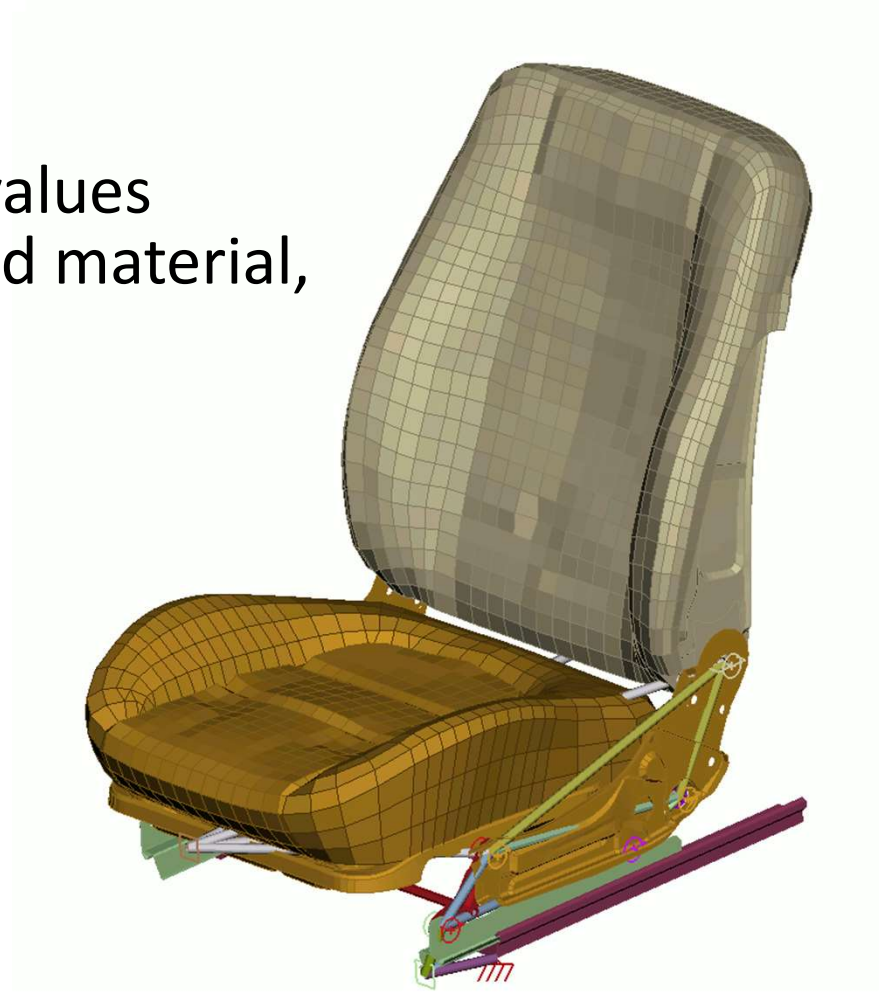
Types of Parameterization

- Shape modification
  → **Morphing**
- Modification of entity card values (e.g. property thickness, used material, connection properties)
  → **ANSA Parameter**



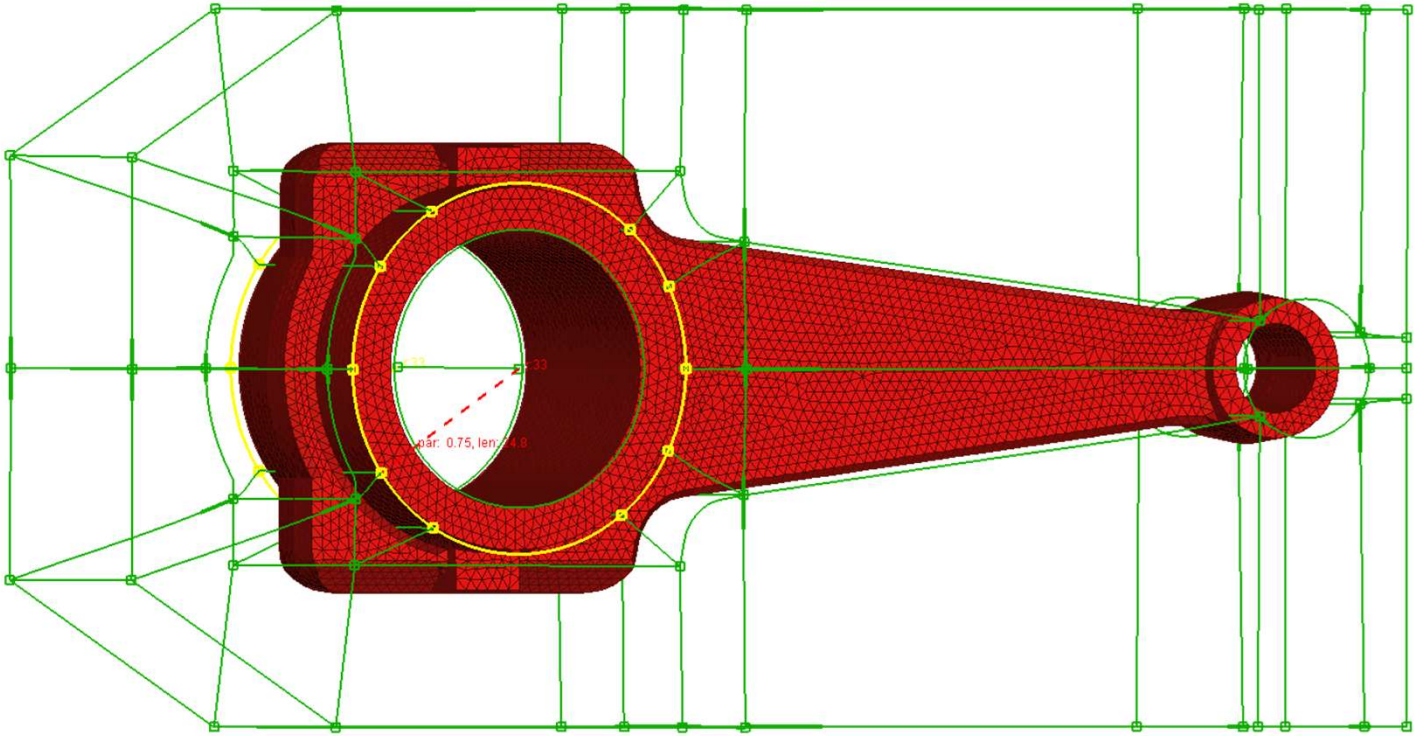
Types of Parameterization

- Shape modification
  → **Morphing**
- Modification of entity card values
  (e.g. property thickness, used material, connection properties)
  → **ANSA Parameter**
- Anything else
  (e.g. Mesh Studies, Kinetics)
  → **Scripting**



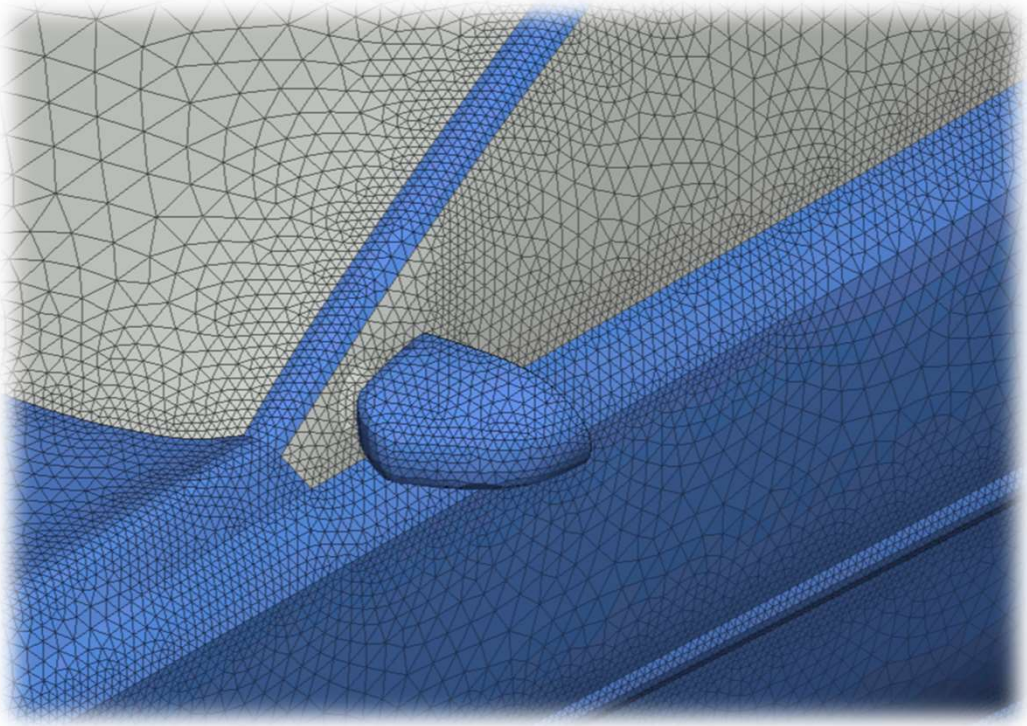
Morphing

- Applicable on FE- and Geometry
- Two main methods:
  - Box Morphing



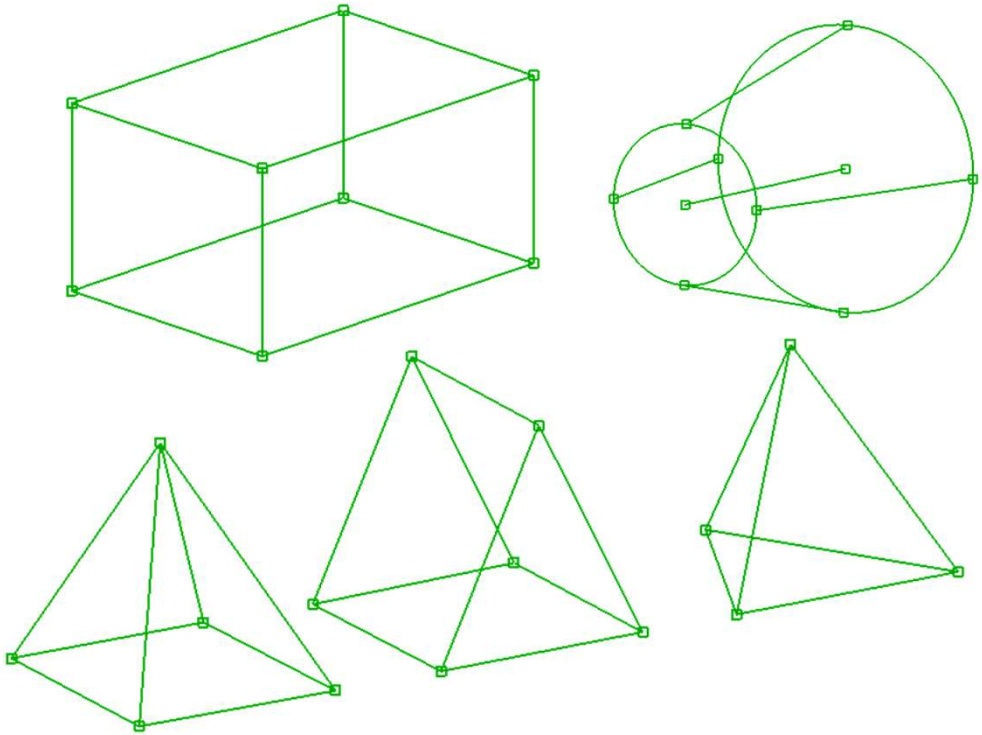
Morphing

- Applicable on FE- and Geometry
- Two main methods:
  - Box Morphing
  - Direct Morphing



Box Morphing

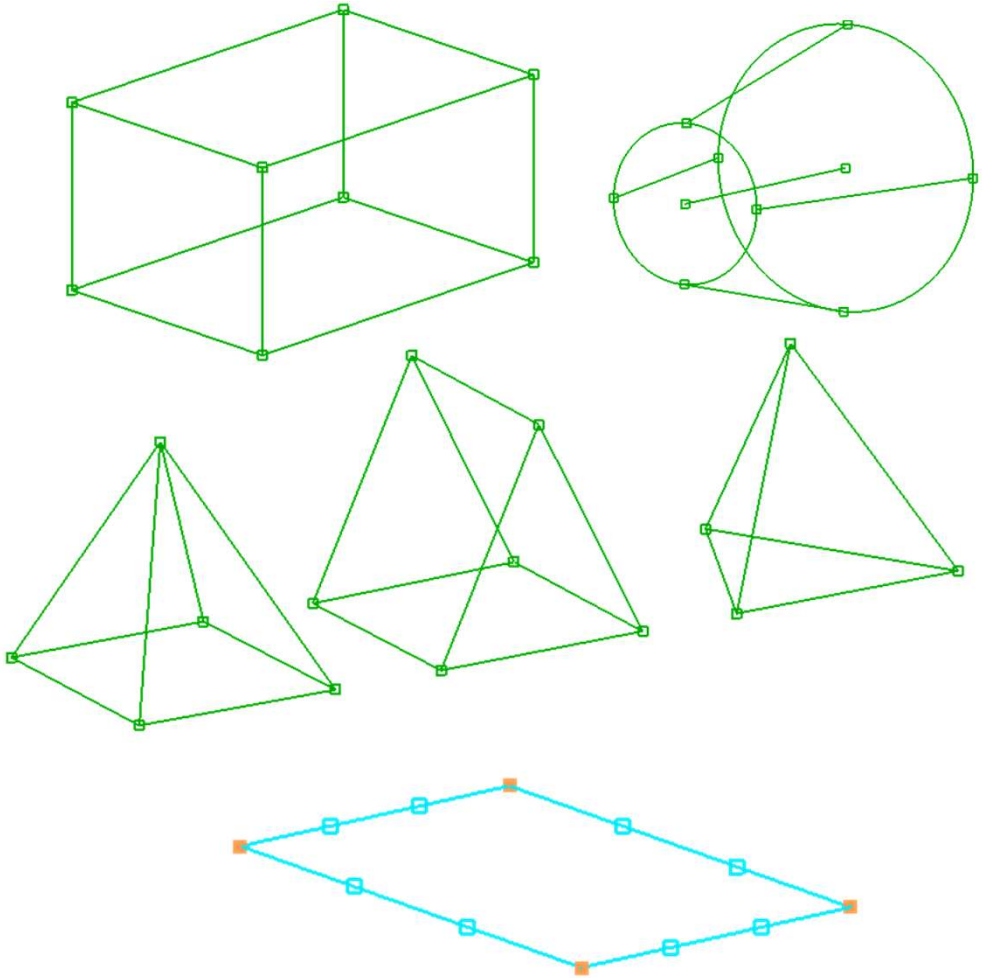
Types of boxes



- 3D
  - Hexa
  - Penta
  - Tetra
  - Pyramid
  - Cylindrical

Box Morphing

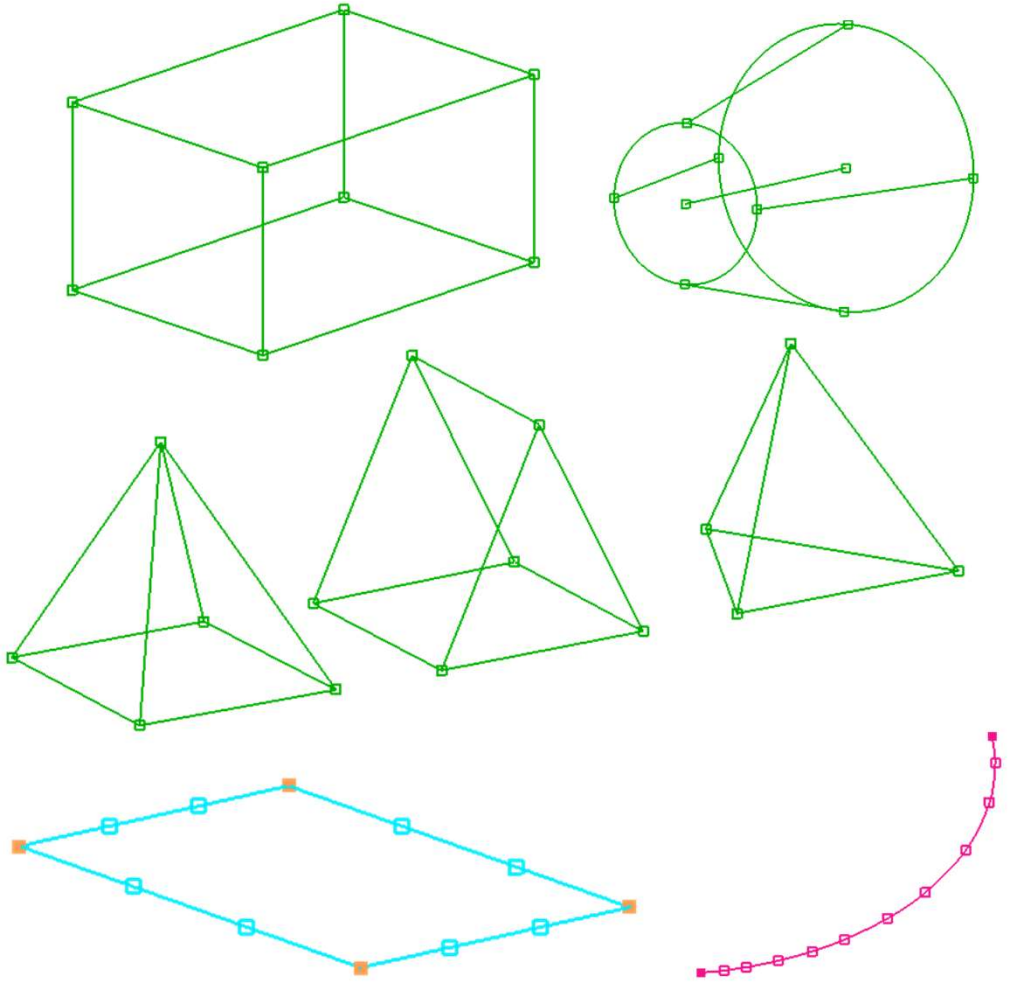
Types of boxes



- 3D
  - Hexa
  - Penta
  - Tetra
  - Pyramid
  - Cylindrical
- 2D (specific thickness)

Box Morphing

Types of boxes

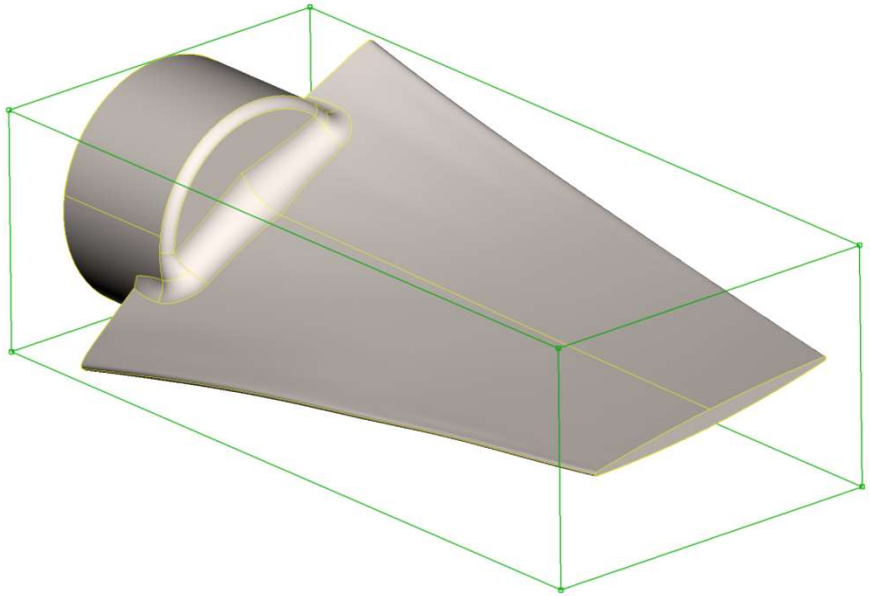


- 3D
  - Hexa
  - Penta
  - Tetra
  - Pyramid
  - Cylindrical
- 2D (specific thickness)
- 1D (specific diameter)

Box Morphing

How to create?

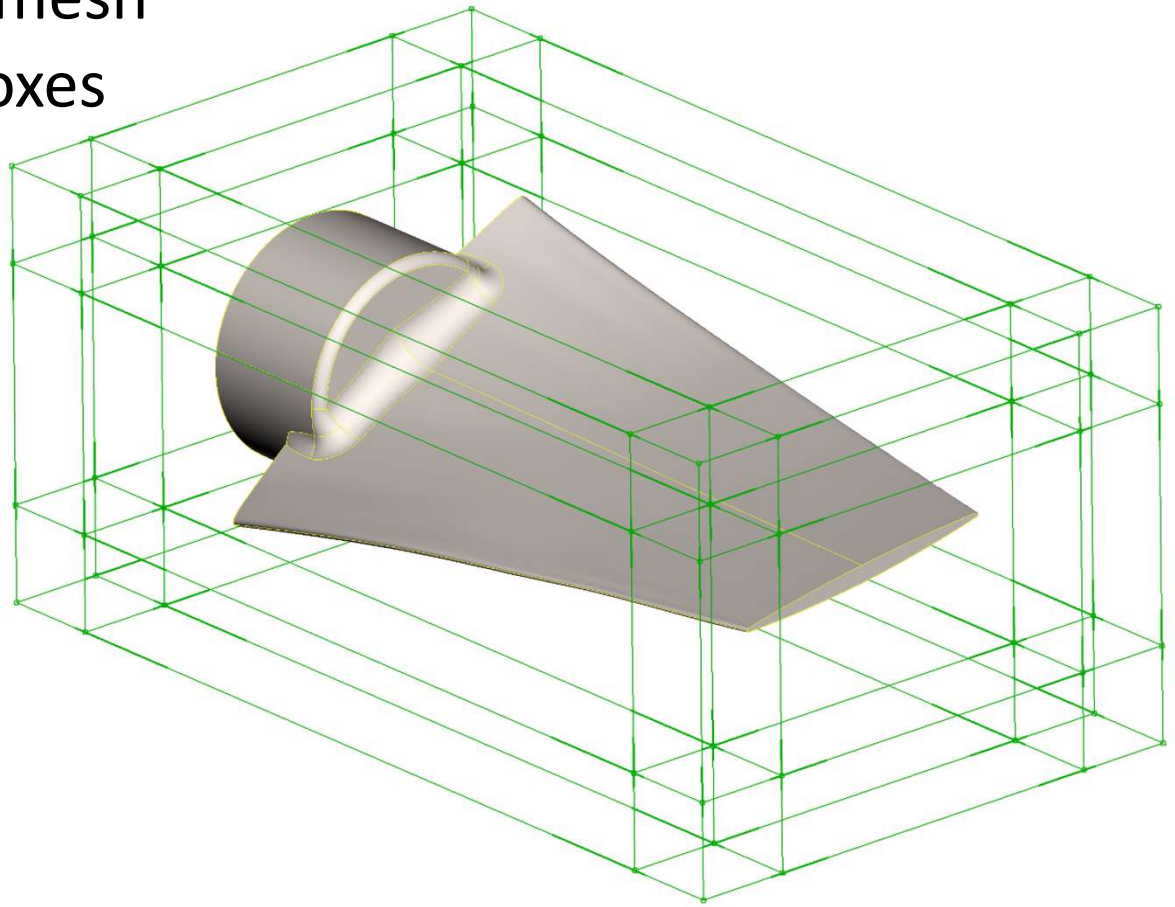
- Around geometry / mesh



Box Morphing

How to create?

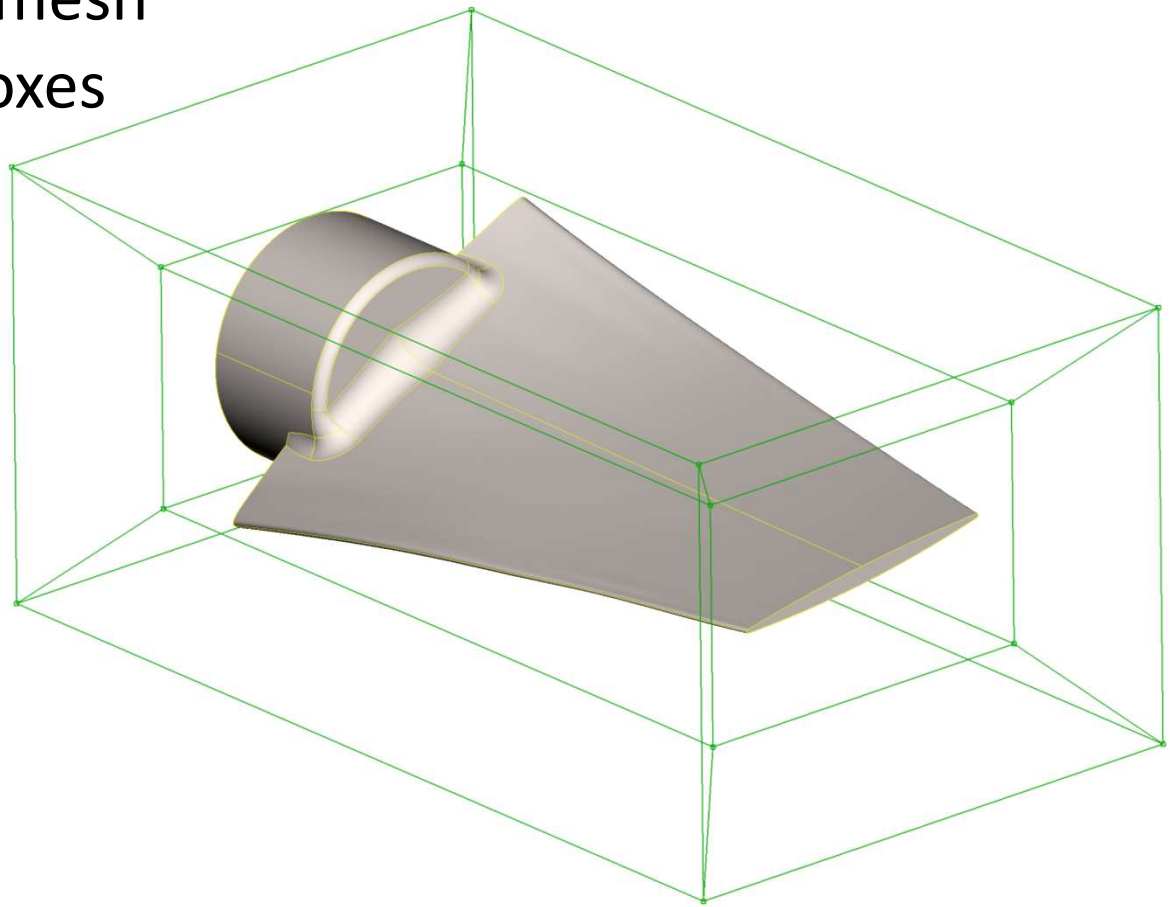
- Around geometry / mesh
- Offset on existing boxes



Box Morphing

How to create?

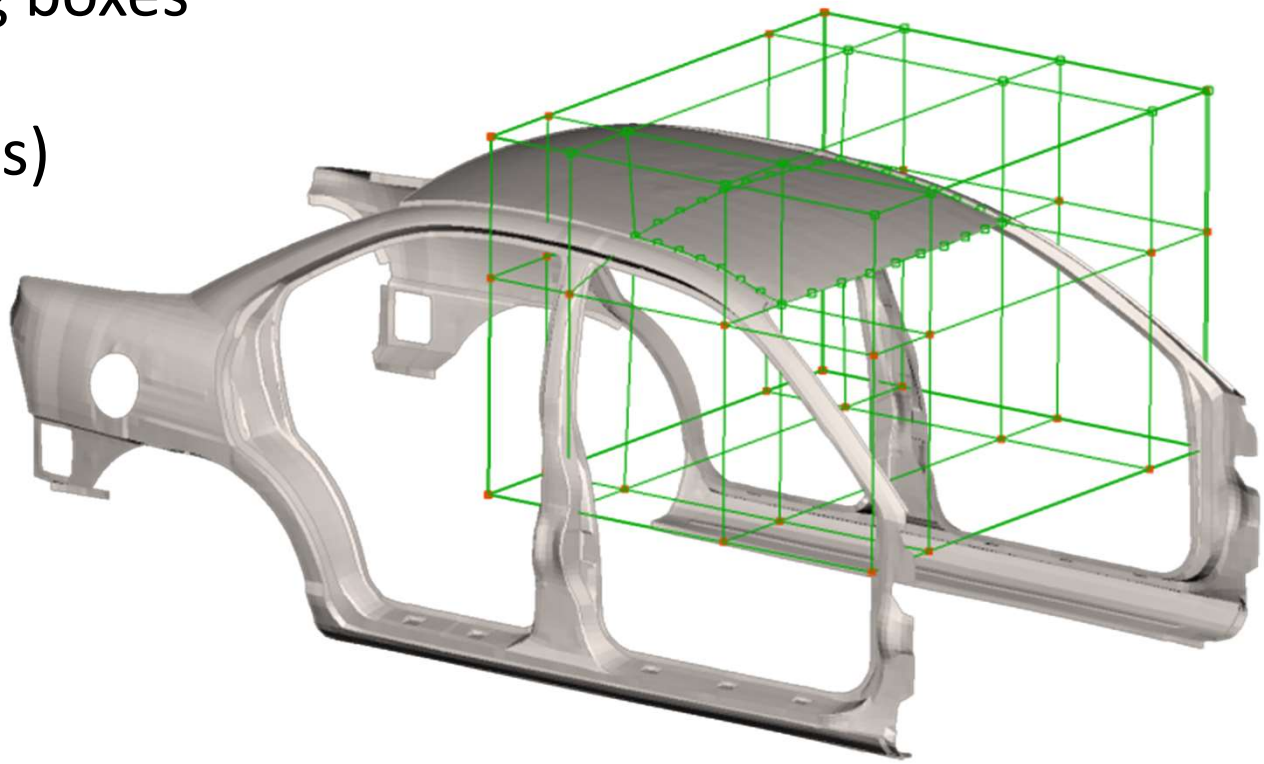
- Around geometry / mesh
- Offset on existing boxes



Box Morphing

How to create?

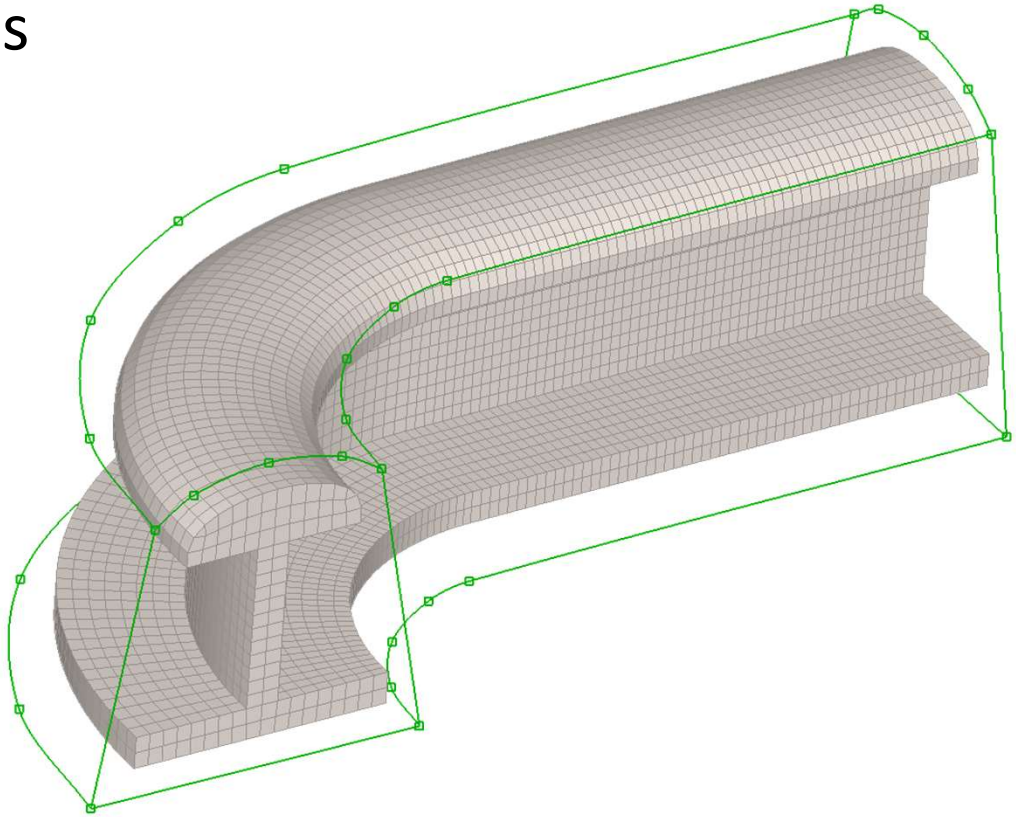
- Around geometry / mesh
- Offset on existing boxes
- Split + Fit
  (edges or surfaces)



Box Morphing

How to create?

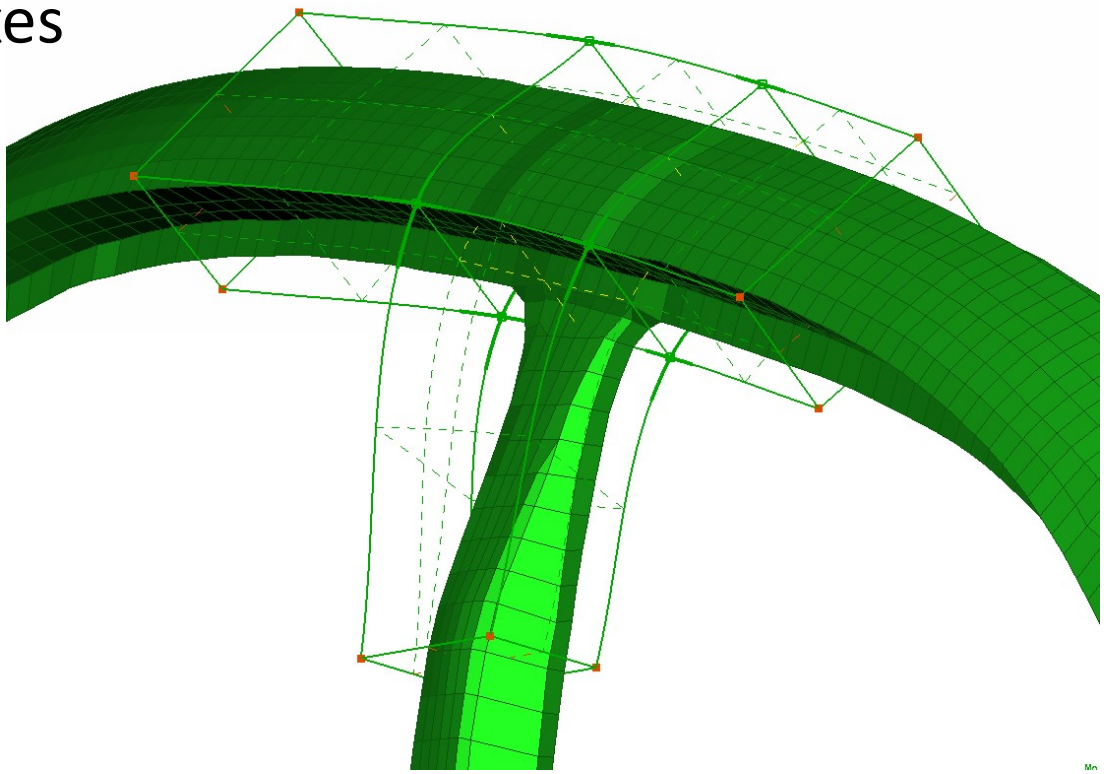
- Around geometry / mesh
- Offset on existing boxes
- Split + Fit
  (edges or surfaces)
- Sweep / Glide



Box Morphing

How to create?

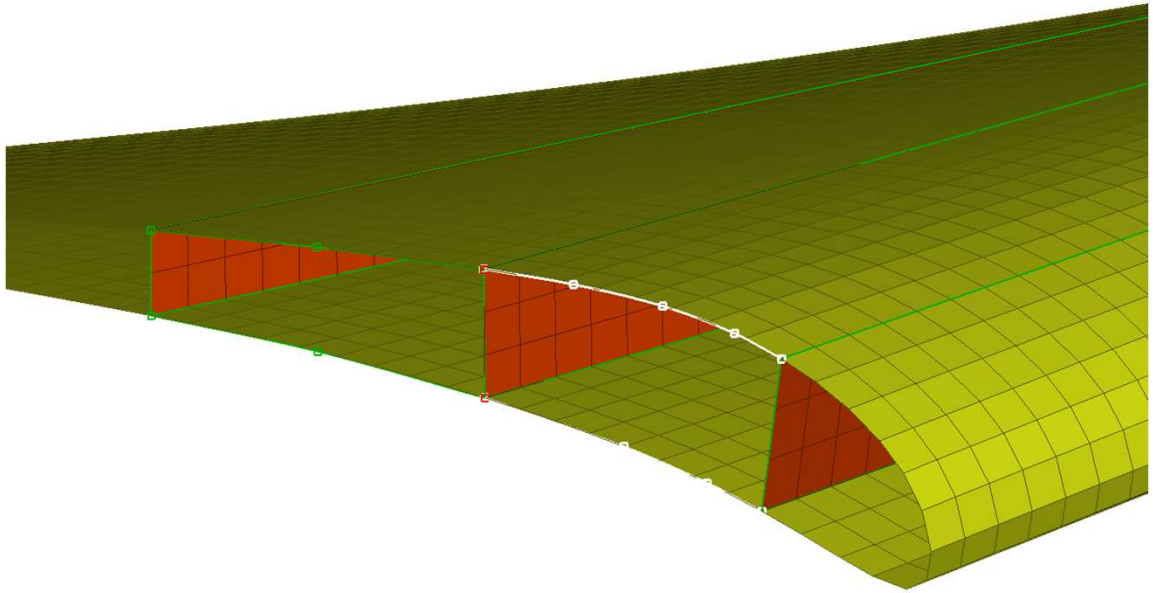
- Around geometry / mesh
- Offset on existing boxes
- Split + Fit
  (edges or surfaces)
- Sweep / Glide
- Wrap
- ...



Box Morphing

How to modify?

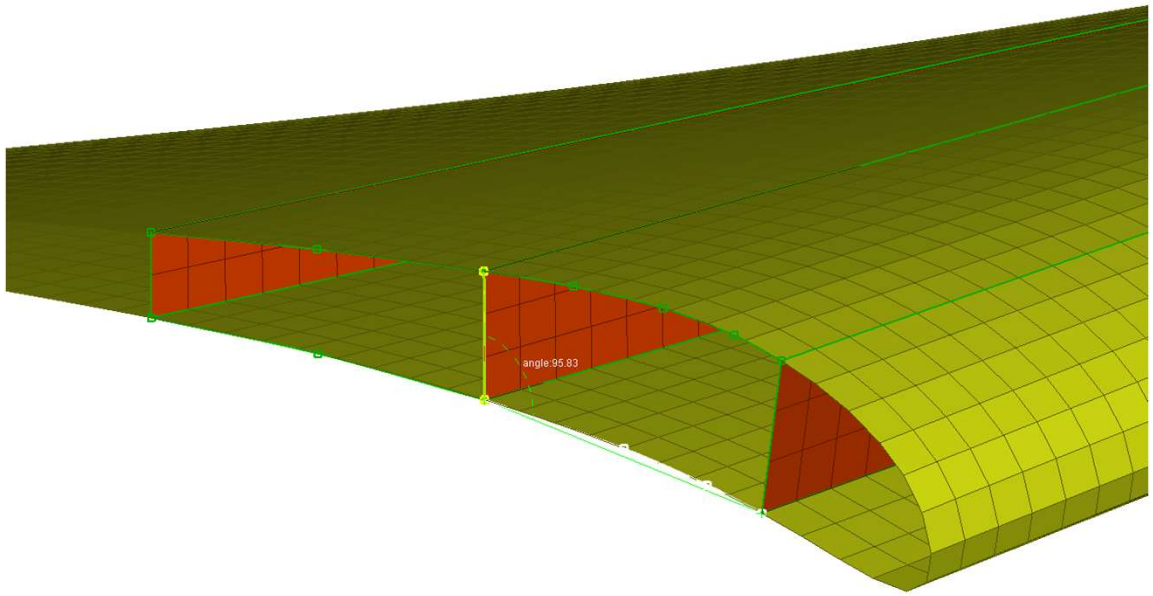
- Move (Translate, Rotate)
- Slide / Extend



Box Morphing

How to modify?

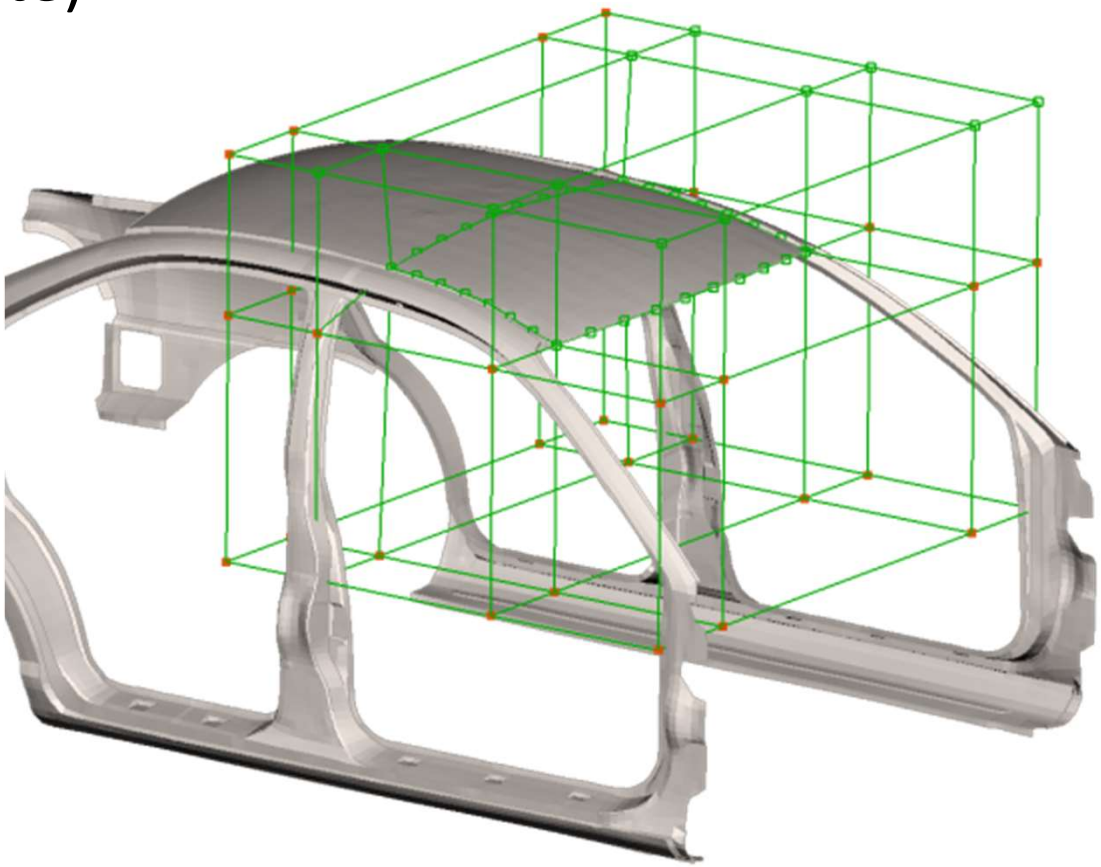
- Move (Translate, Rotate)
- Slide / Extend
- Angle



Box Morphing

How to modify?

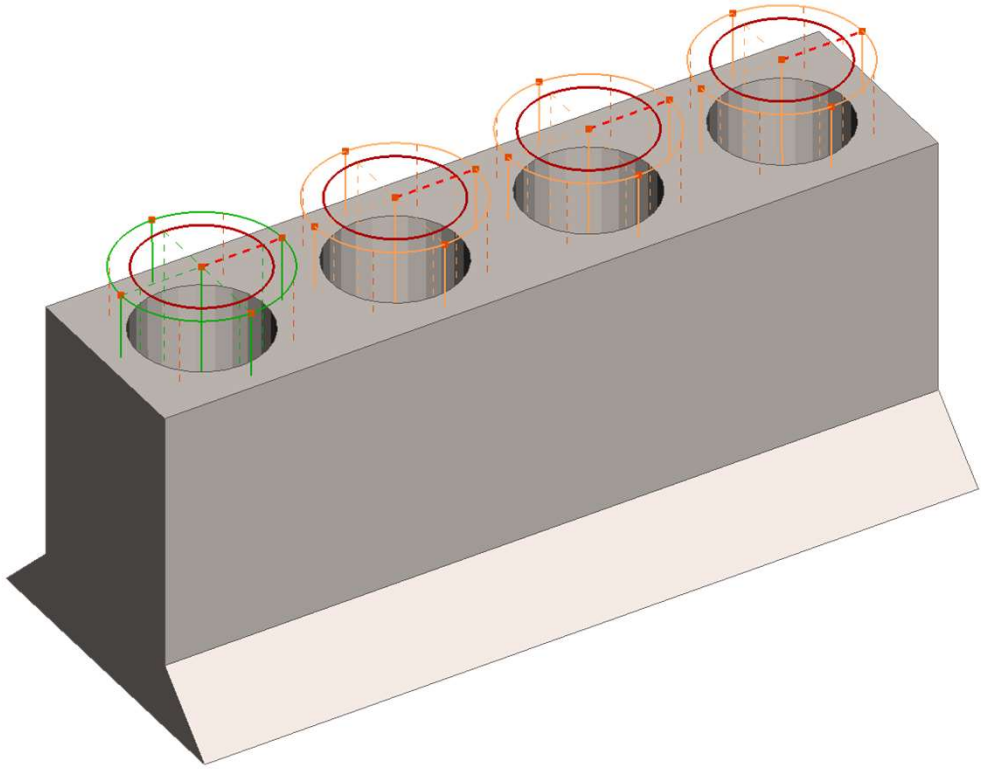
- Move (Translate, Rotate)
- Slide / Extend
- Angle
- Fit (edges, surfaces)



Box Morphing

How to modify?

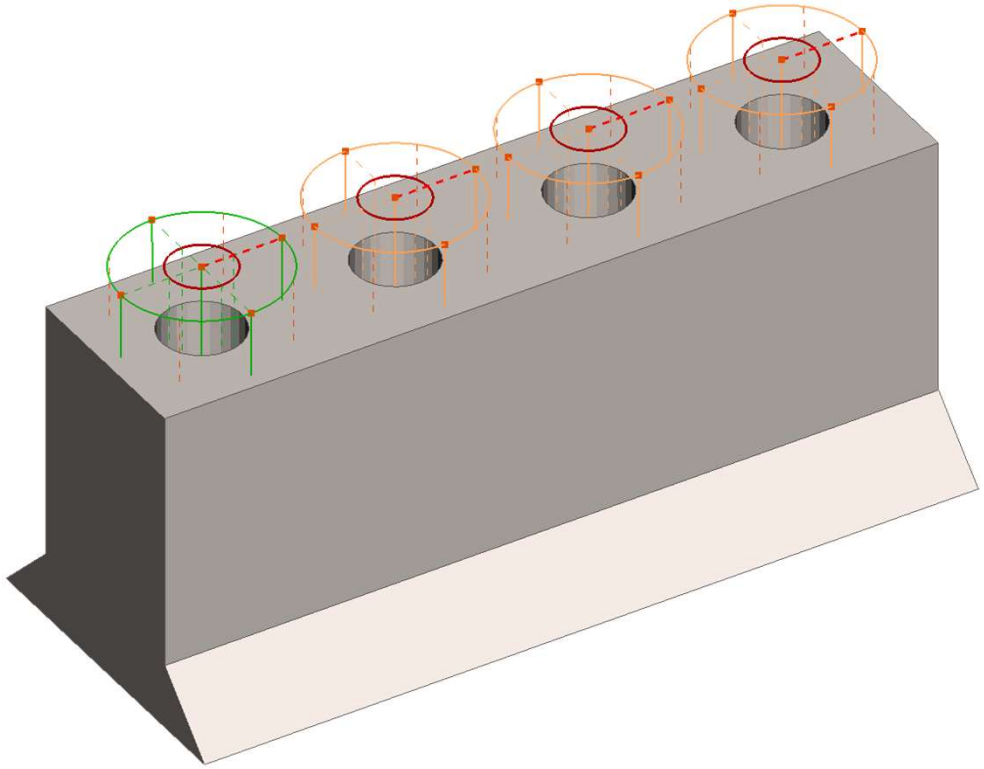
- Move (Translate, Rotate)
- Slide / Extend
- Angle
- Fit (edges, surfaces)
- Radius



Box Morphing

How to modify?

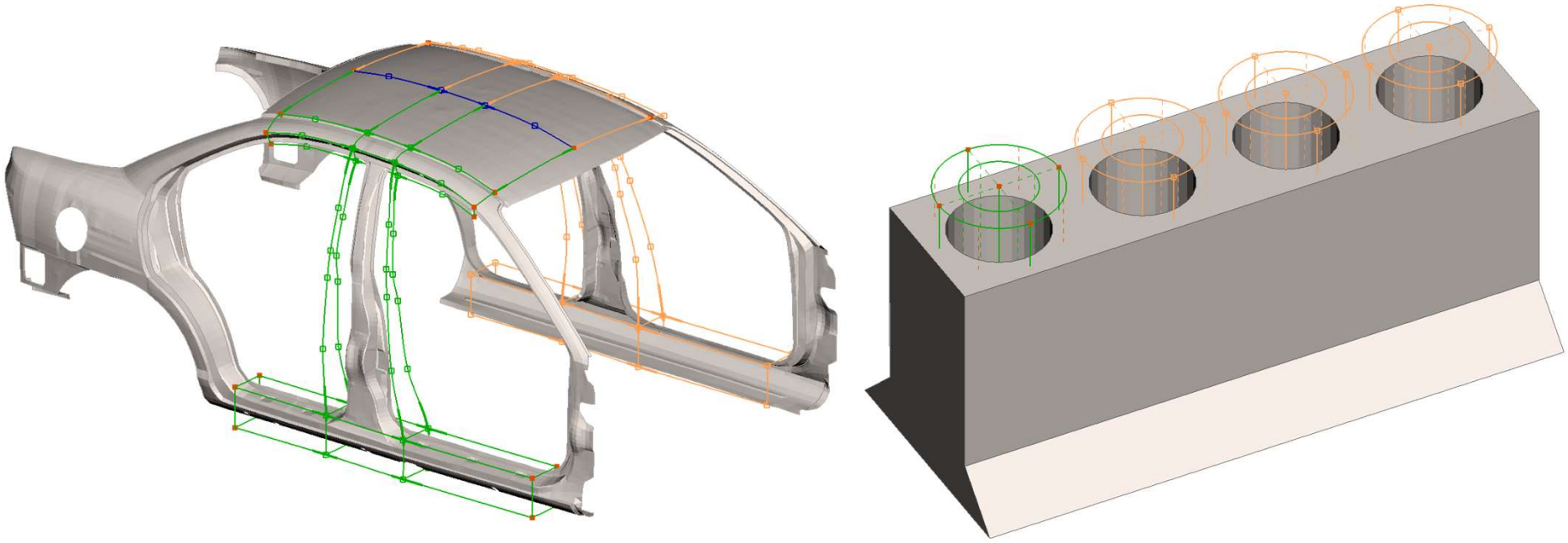
- Move (Translate, Rotate)
- Slide / Extend
- Angle
- Fit (edges, surfaces)
- Radius



Box Morphing

Linked Morphing Boxes

- Utilize model symmetry
- Link according symmetry-/mirror plane, translation vector



Box Morphing

Linked Morphing Boxes

- Utilize model symmetry
- Link according symmetry-/mirror plane, translation vector or rotation axis

Box Morphing

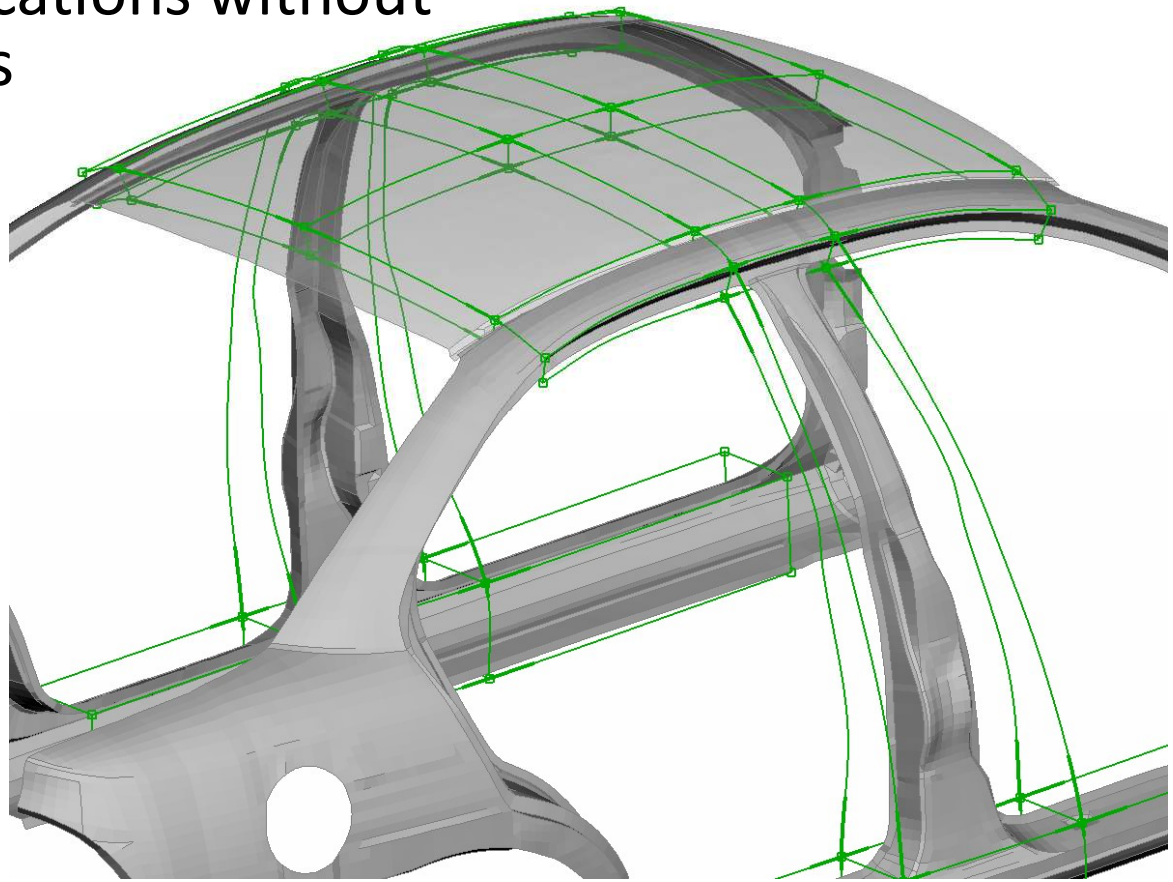
Box in Box

- Separate groups of boxes handle different features
- Global and local modifications without excessive splits of boxes

Box Morphing

Box in Box

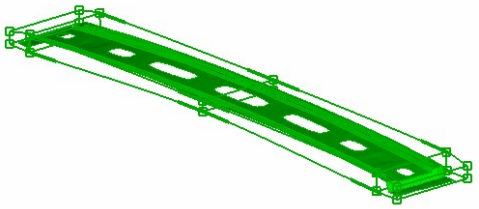
- Separate groups of boxes handle different features
- Global and local modifications without excessive splits of boxes
- Global: B-pillar position



Box Morphing

Box in Box

- Separate groups of boxes handle different features
- Global and local modifications without excessive splits of boxes



- Global: B-pillar position
- Local: cross member width

Box Morphing

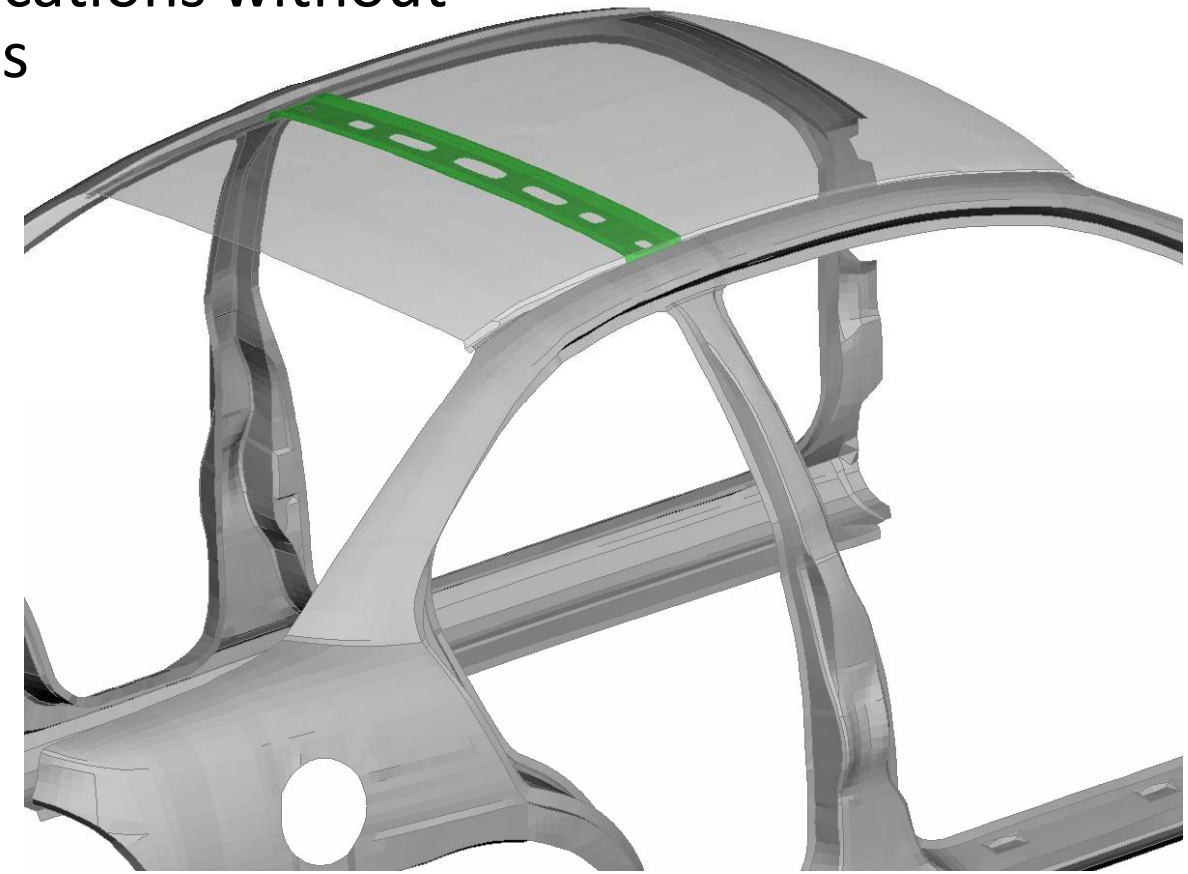
Box in Box

- Separate groups of boxes handle different features
- Global and local modifications without excessive splits of boxes

Box Morphing

Box in Box

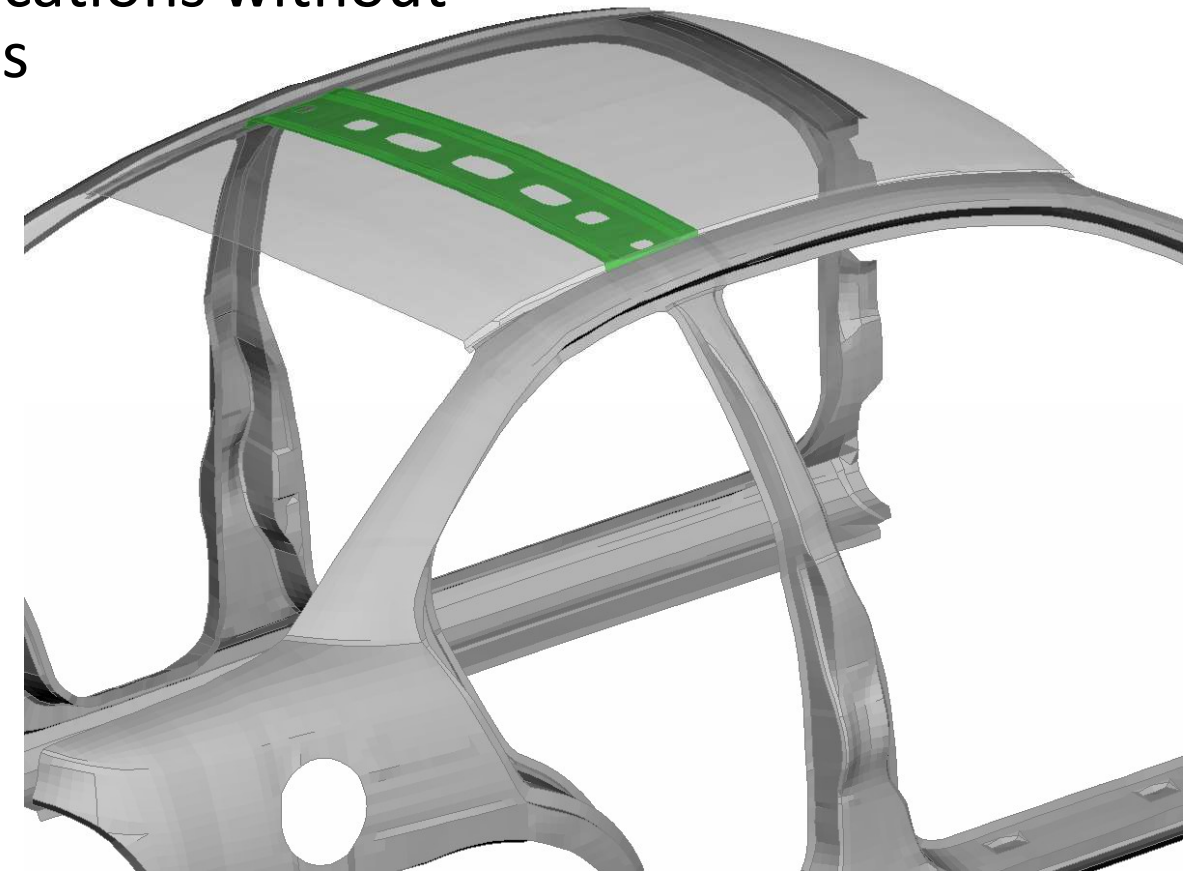
- Separate groups of boxes handle different features
- Global and local modifications without excessive splits of boxes
- Global morphing



Box Morphing

Box in Box

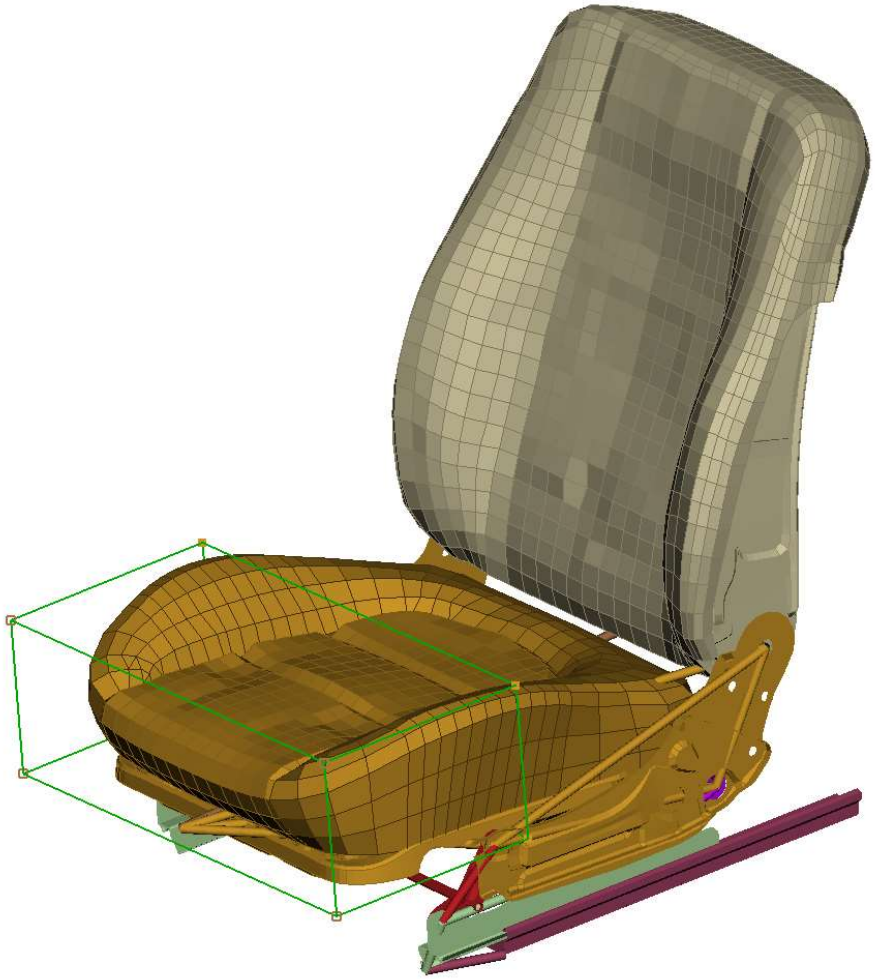
- Separate groups of boxes handle different features
- Global and local modifications without excessive splits of boxes



- Global morphing
- Local morphing

Box Morphing

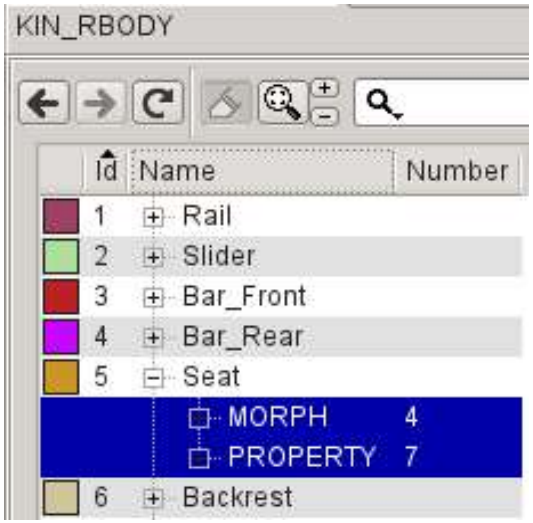
Coupled with Kinetics

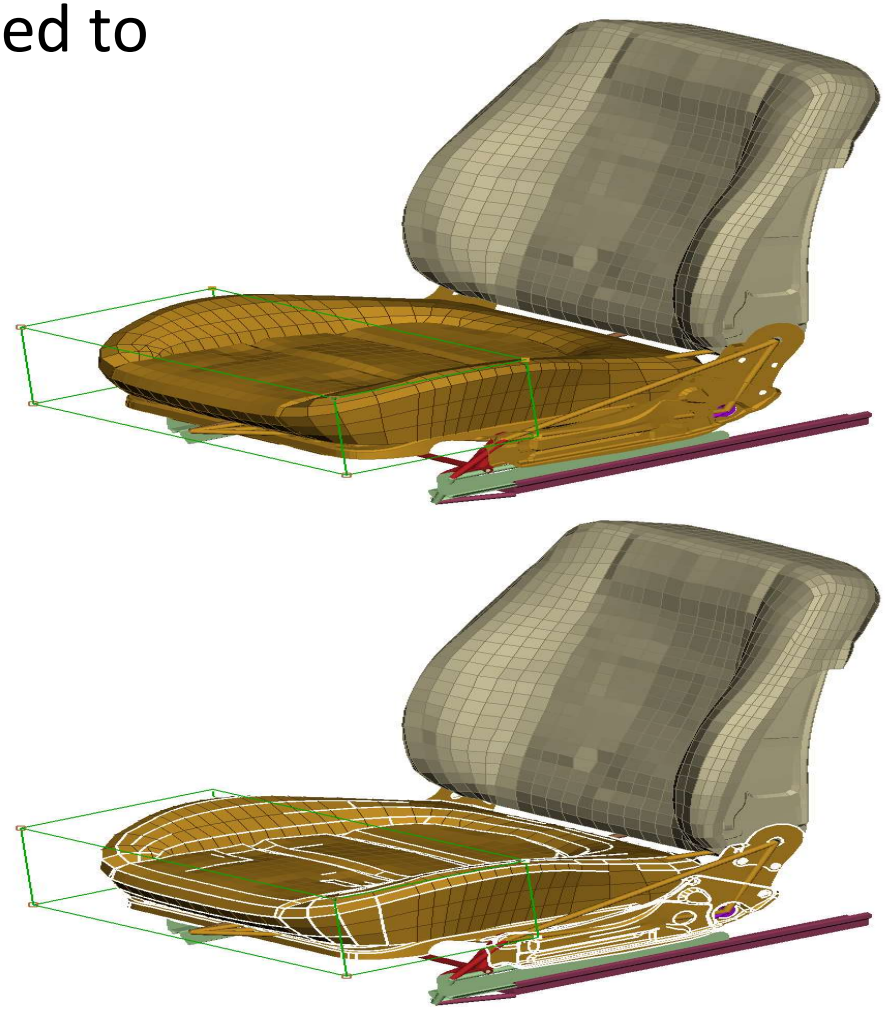


Box Morphing

Coupled with Kinetics

- Morph Control Points added to Kinetic Rigid Bodies

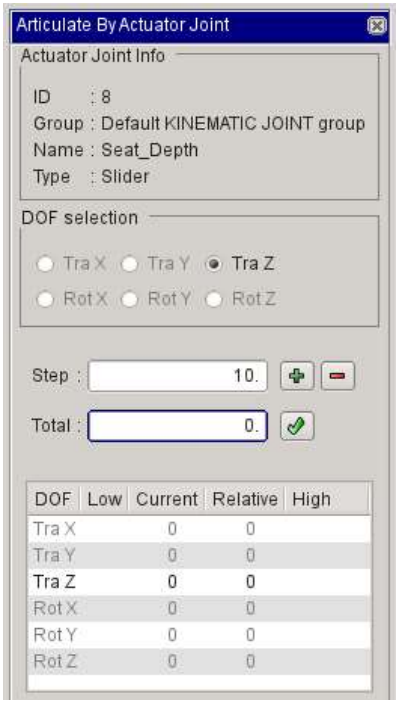


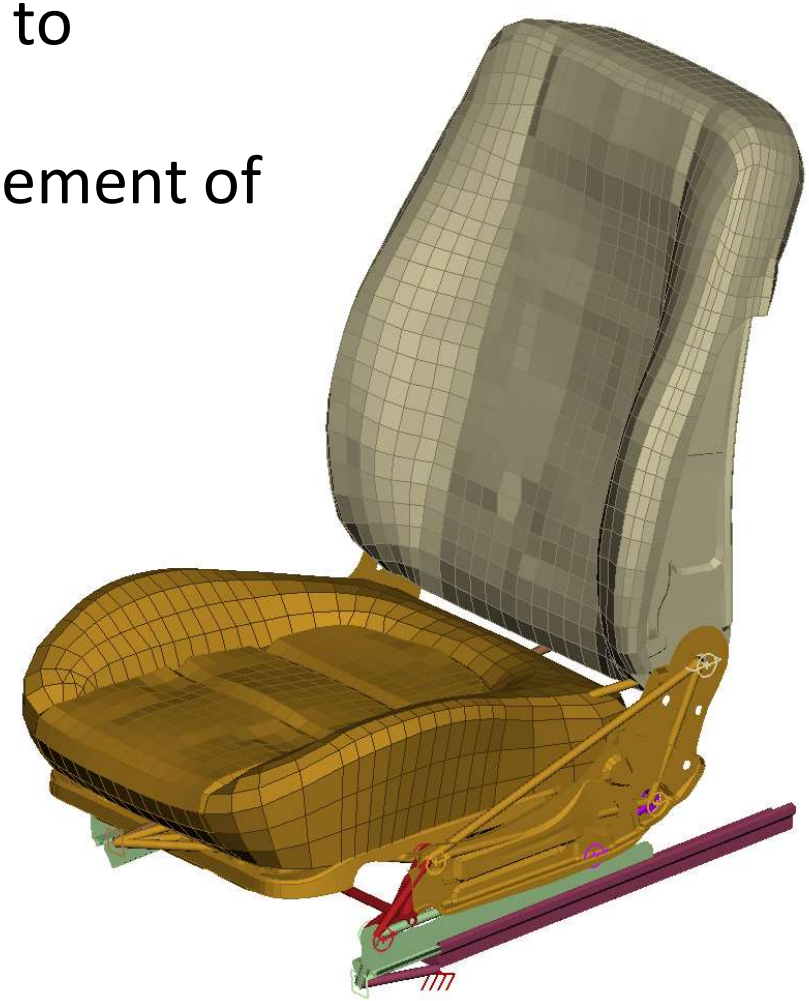


Box Morphing

Coupled with Kinetics

- Morph Control Points added to Kinetic Rigid Bodies
- Morphing controlled by movement of Rigid Bodies

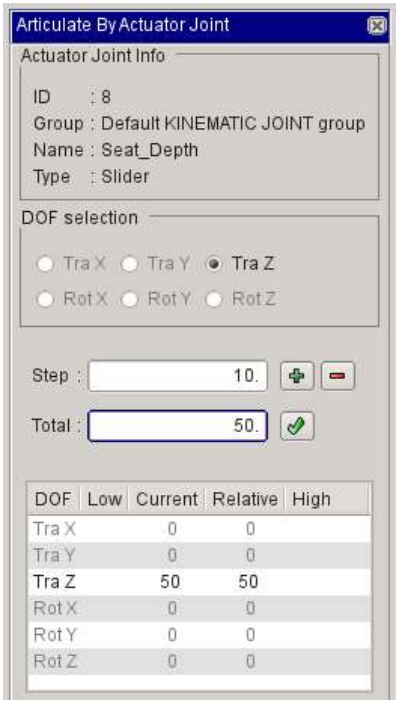


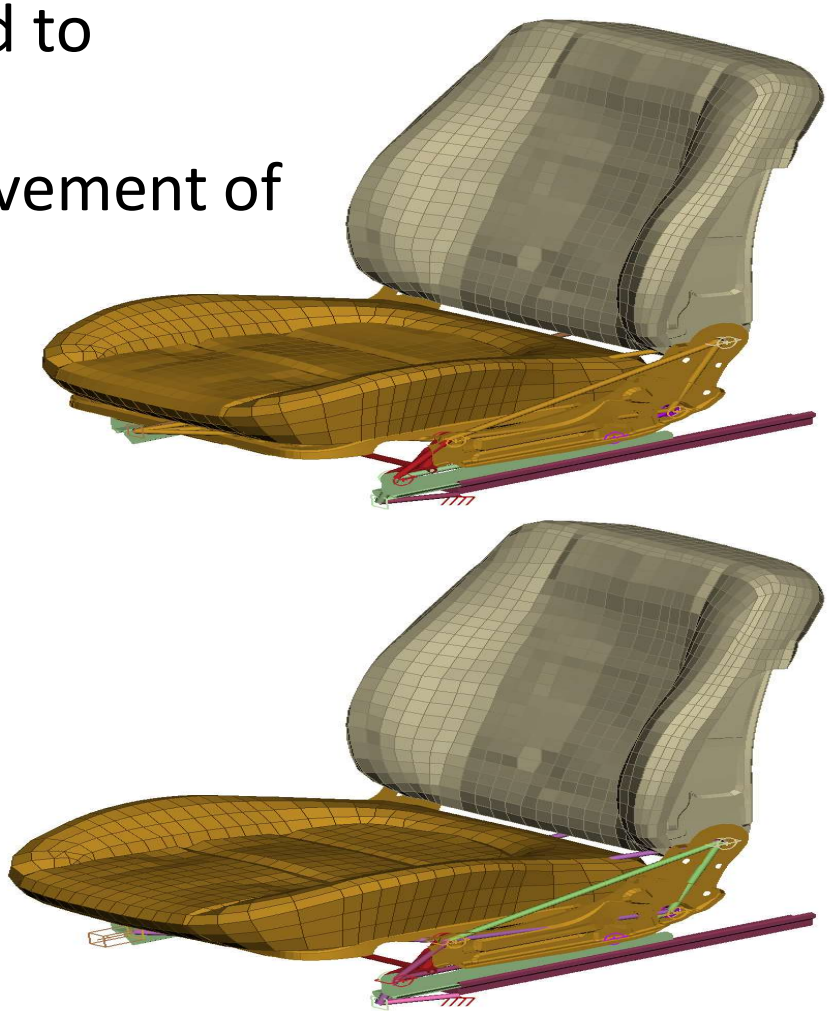


Box Morphing

Coupled with Kinetics

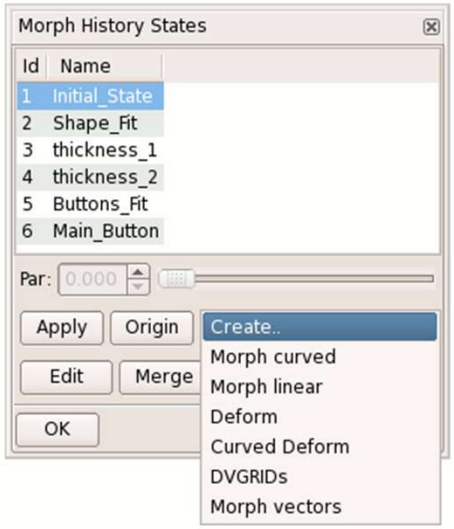
- Morph Control Points added to Kinetic Rigid Bodies
- Morphing controlled by movement of Rigid Bodies





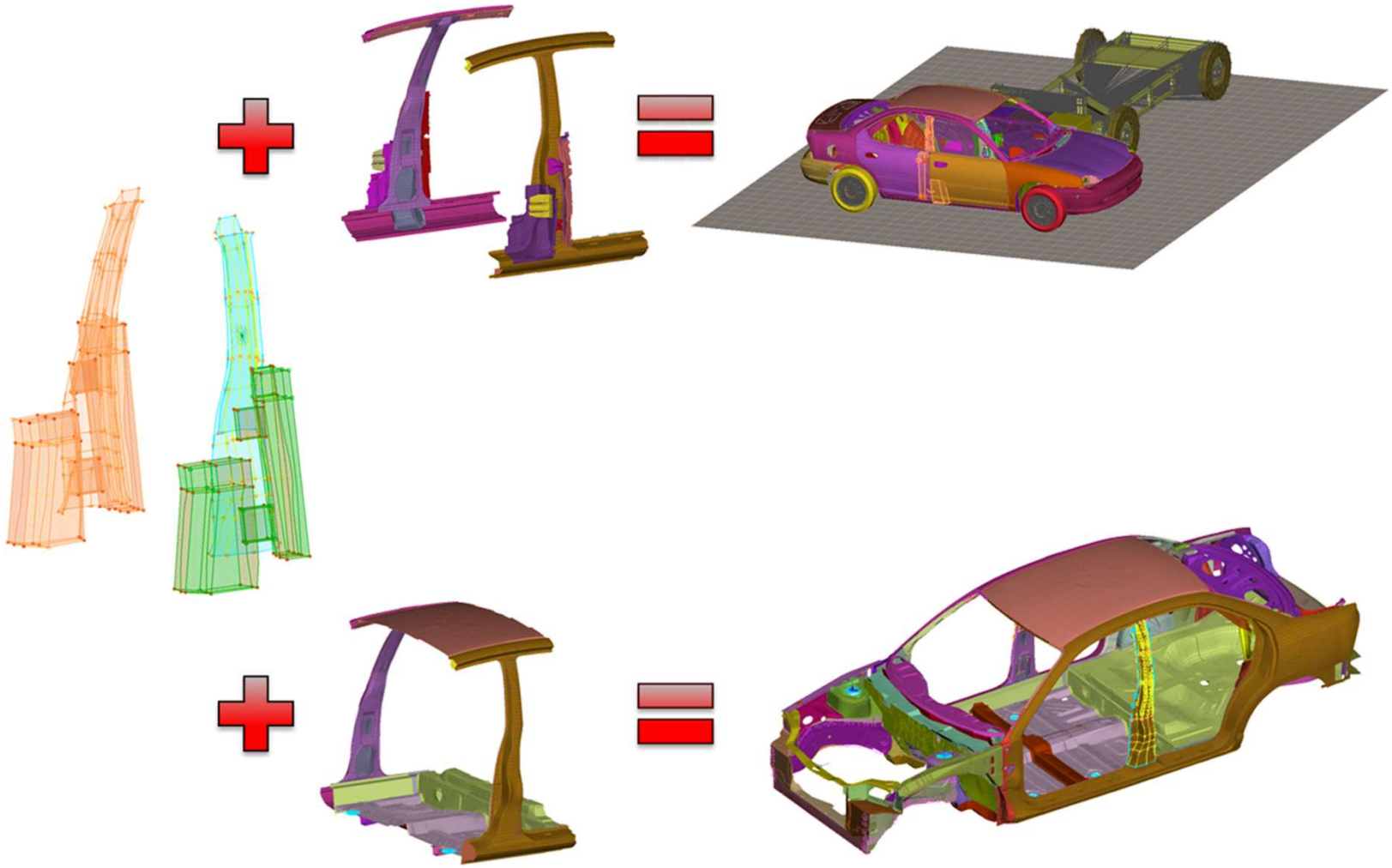
Box Morphing

Recording History



Box Morphing

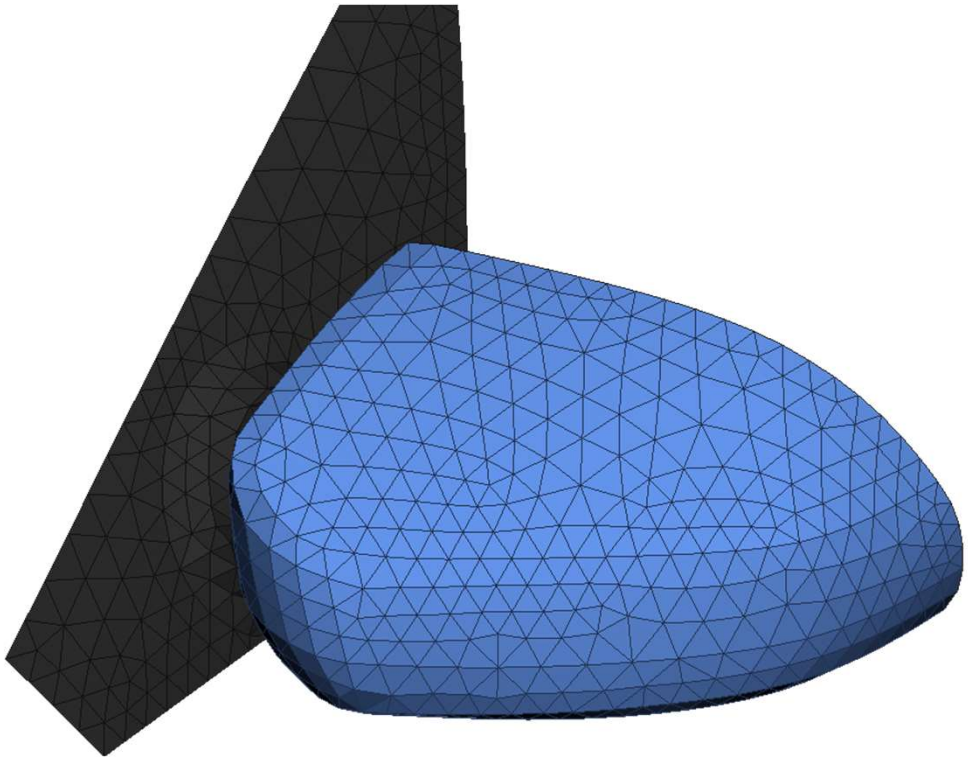
Re-use of boxes and parameters for multiple similar models



Direct Morphing

DFM

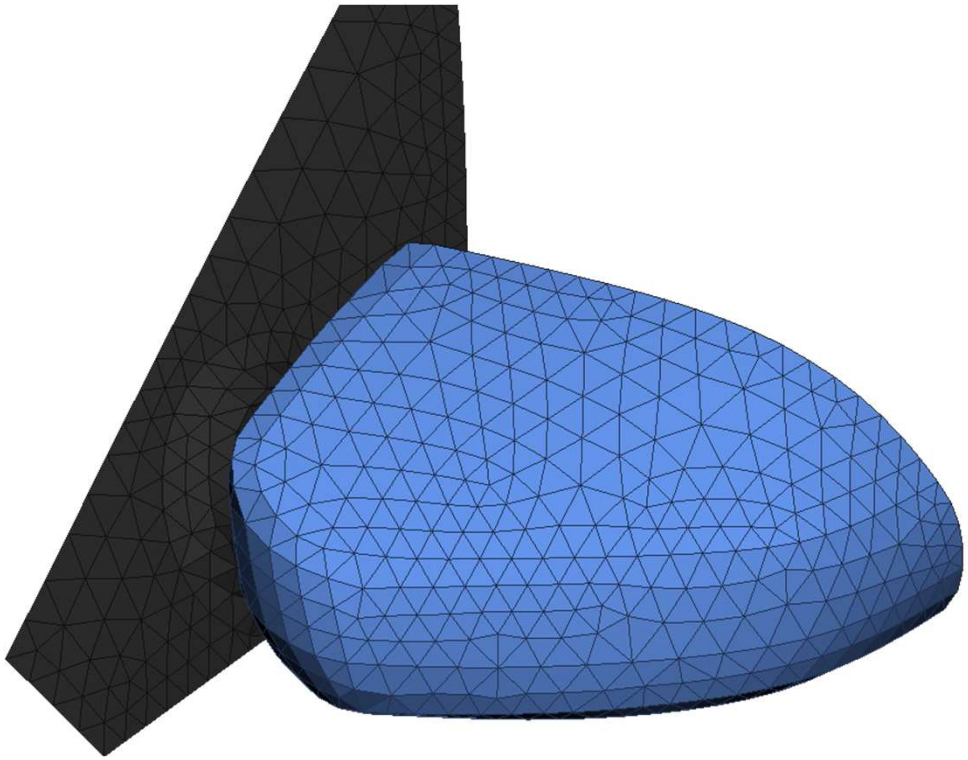
Translate, **rotate** or scale **FE-mesh** or Geometry entities



Direct Morphing

DFM

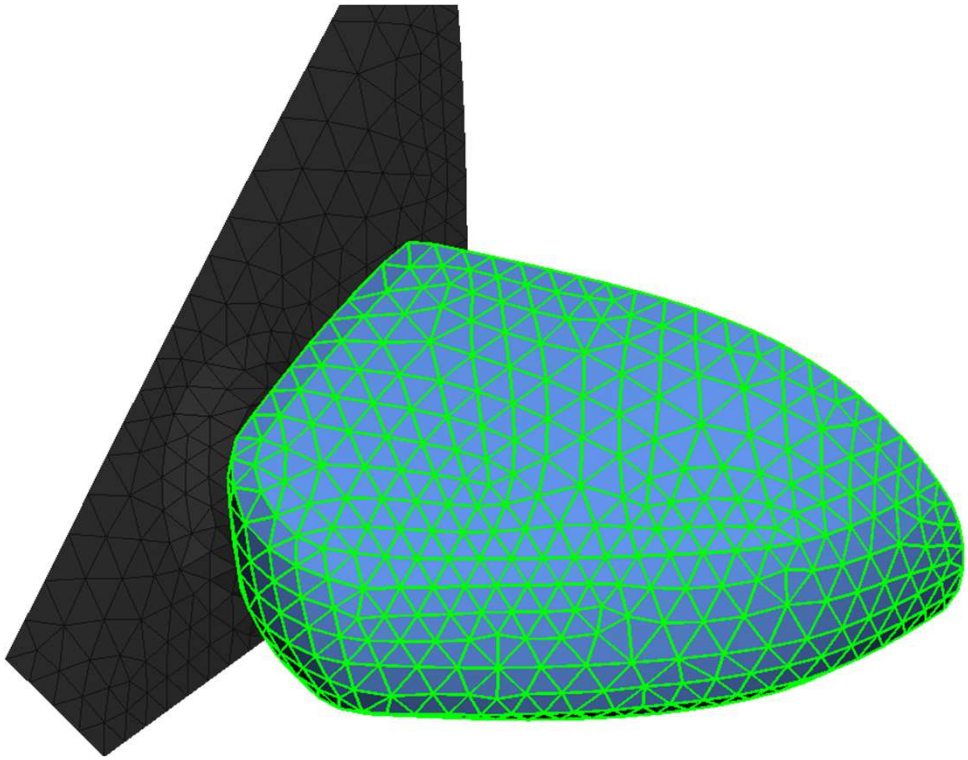
Translate, **rotate** or scale **FE-mesh** or Geometry entities



Direct Morphing

DFM

Translate, **rotate** or scale **FE-mesh** or Geometry entities

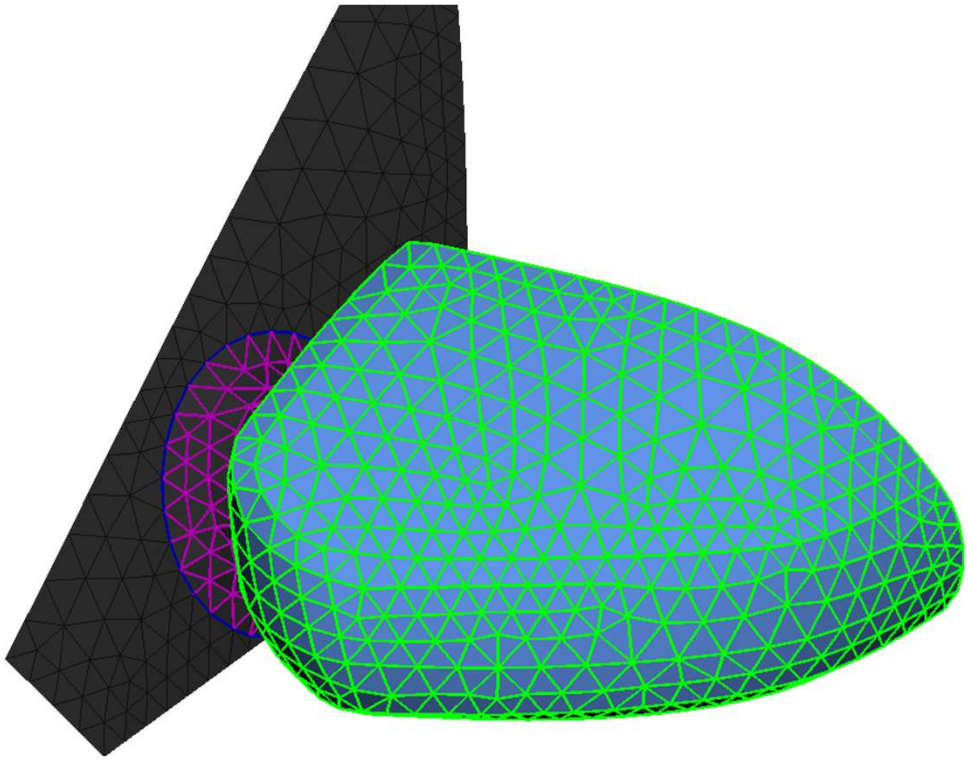


- Control Entities

Direct Morphing

DFM

Translate, **rotate** or scale **FE-mesh** or Geometry entities

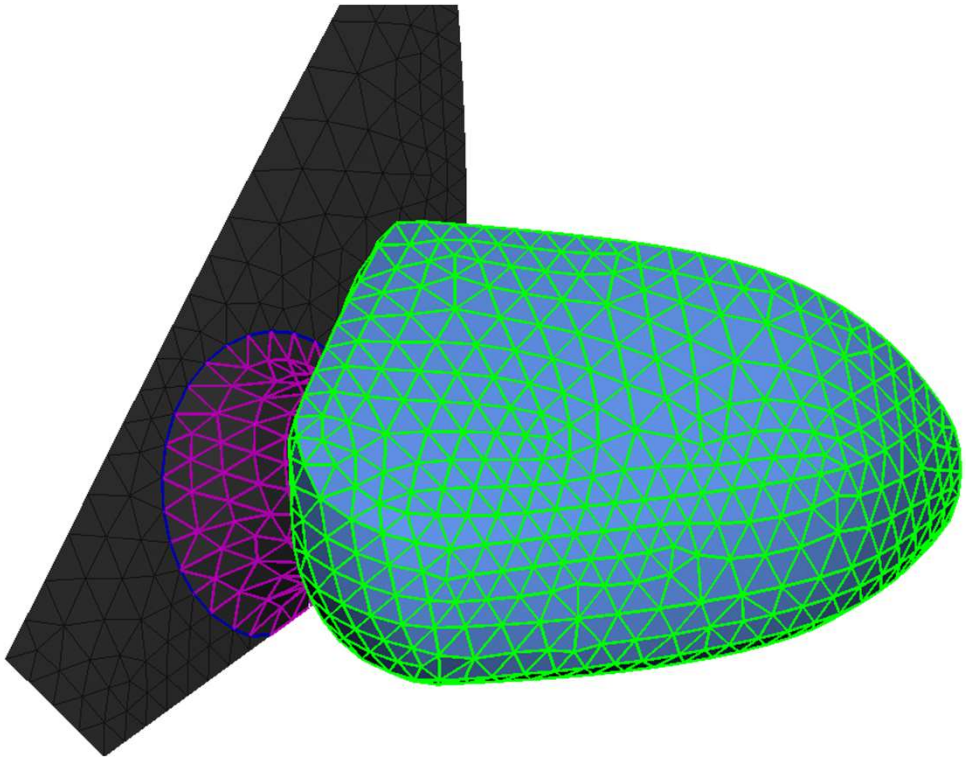


- Control Entities
- Morphed Entities
- Boundary

Direct Morphing

DFM

Translate, **rotate** or scale **FE-mesh** or Geometry entities

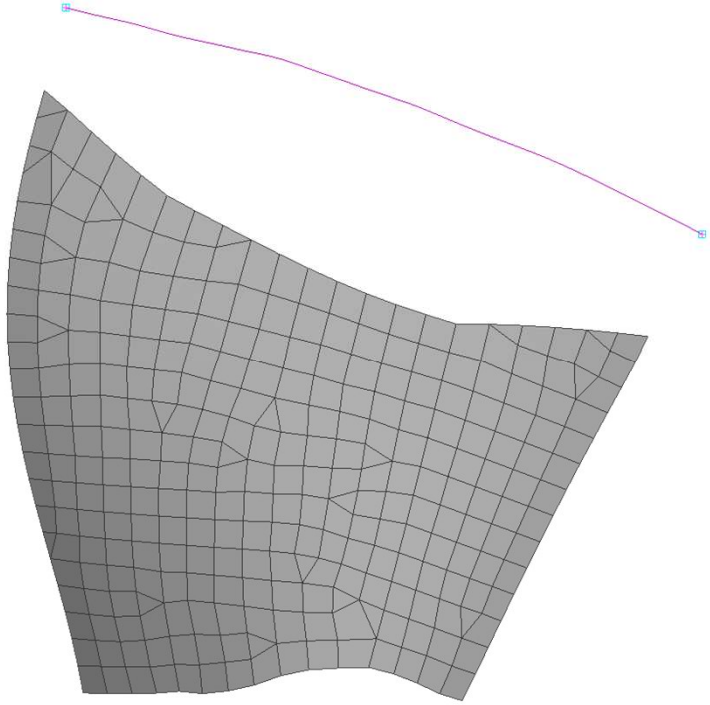


- Control Entities
- Morphed Entities
- Boundary
- Morphing

Direct Morphing

DFM

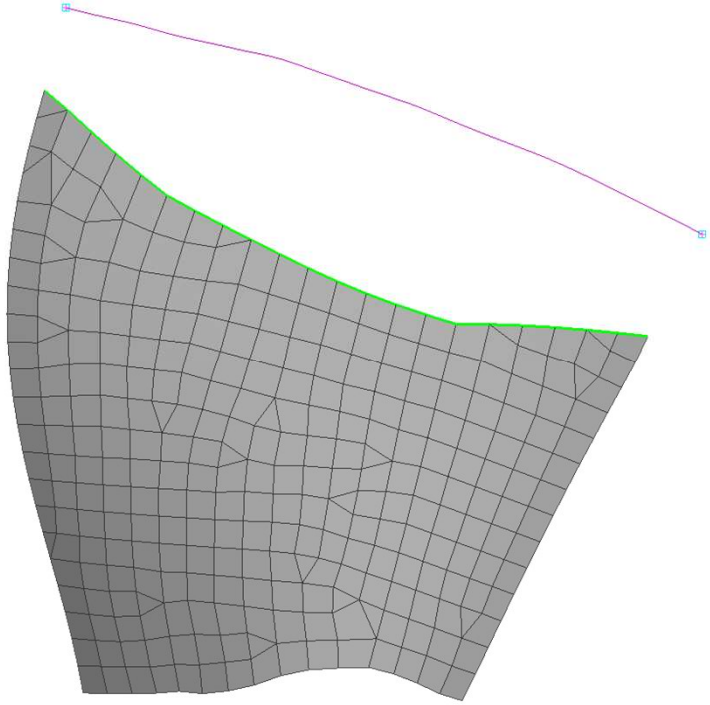
Snap **FE** or geometry edges to **single** or multiple target curves



Direct Morphing

DFM

Snap **FE** or geometry edges to **single** or multiple target curves

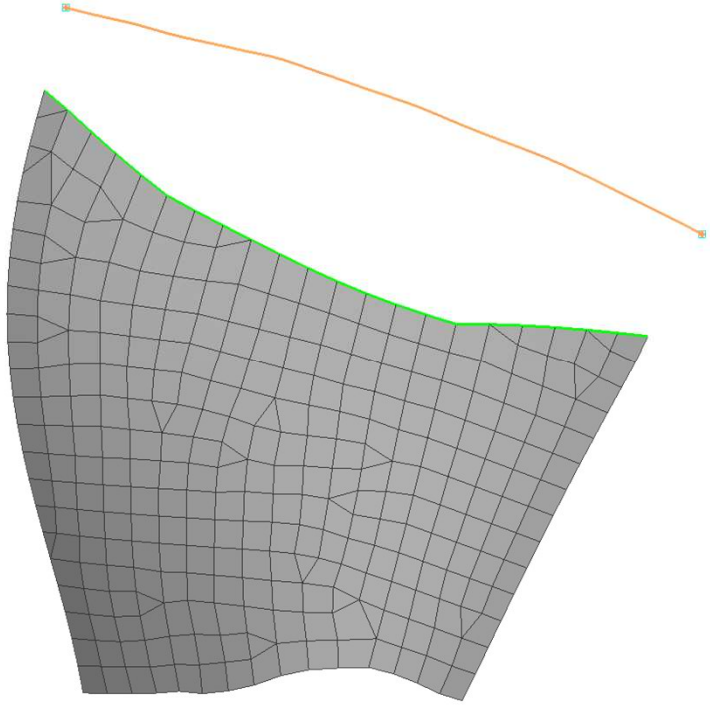


- Origin

Direct Morphing

DFM

Snap **FE** or geometry edges to **single** or multiple target curves

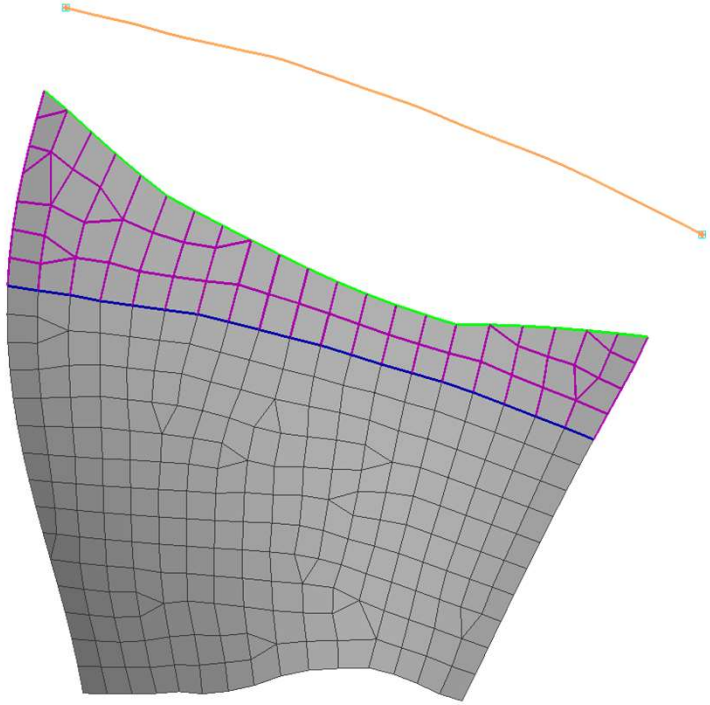


- Origin
- Target

Direct Morphing

DFM

Snap **FE** or geometry edges to **single** or multiple target curves

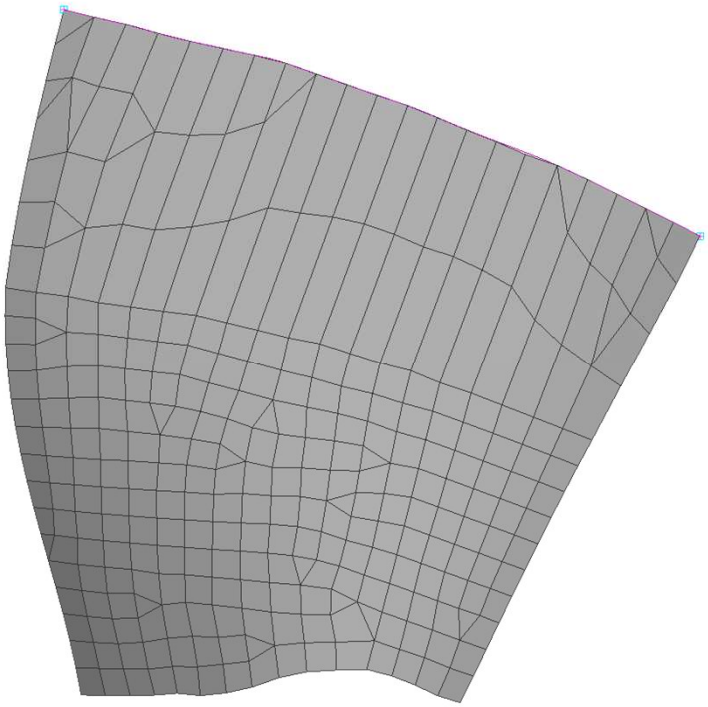


- Origin
- Target
- Morphed Entities
- Boundary

Direct Morphing

DFM

Snap **FE** or geometry edges to **single** or multiple target curves

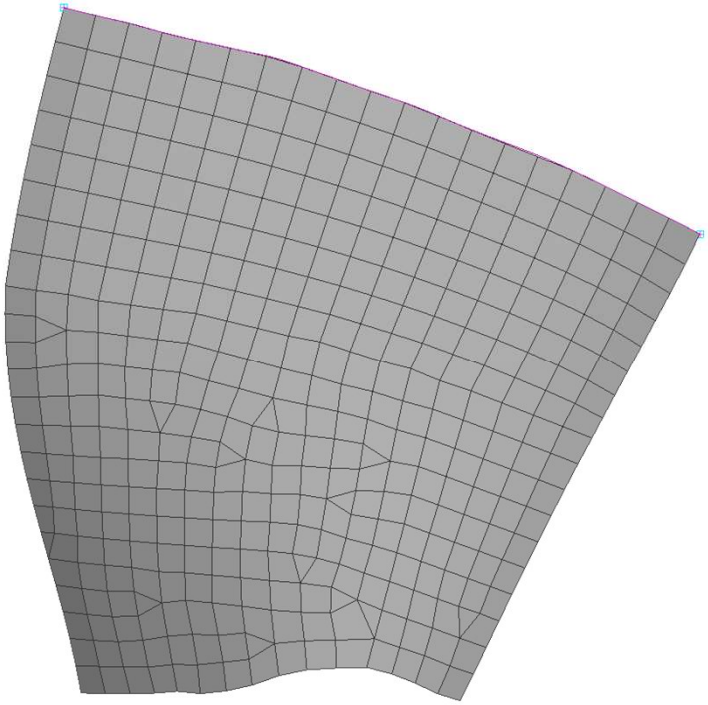


- Origin
- Target
- Morphed Entities
- Boundary
- Morphing

Direct Morphing

DFM

Snap **FE** or geometry edges to **single** or multiple target curves

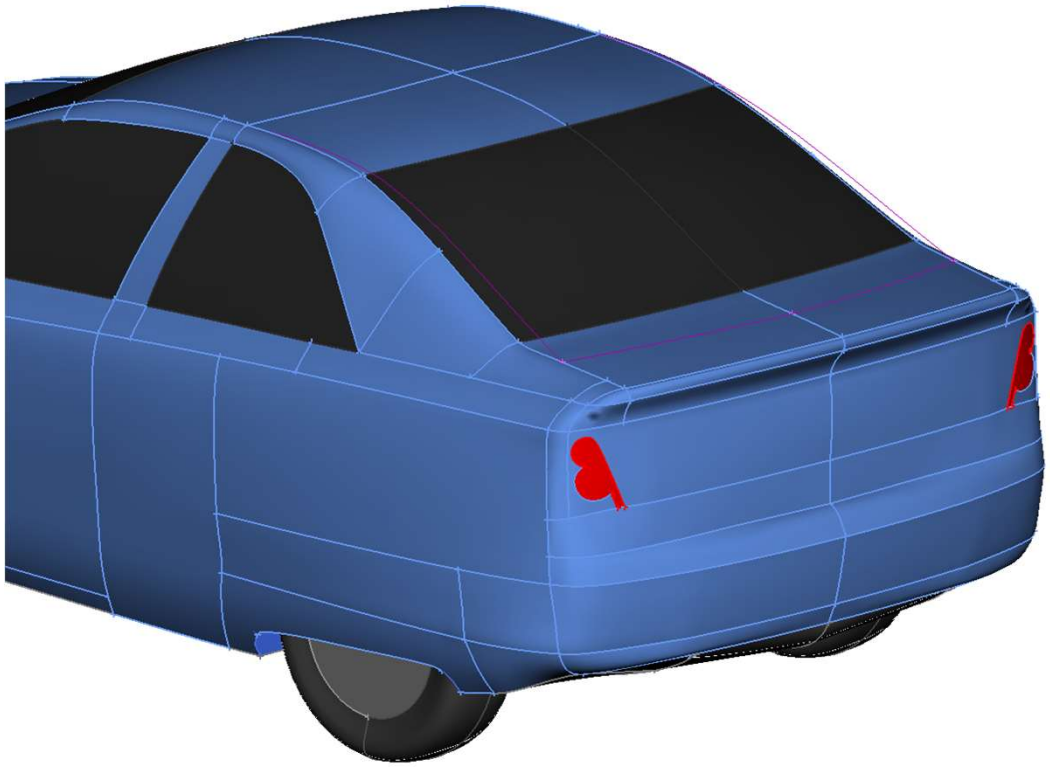


- Origin
- Target
- Morphed Entities
- Boundary
- Morphing
- Reconstruct of morphed area

Direct Morphing

DFM

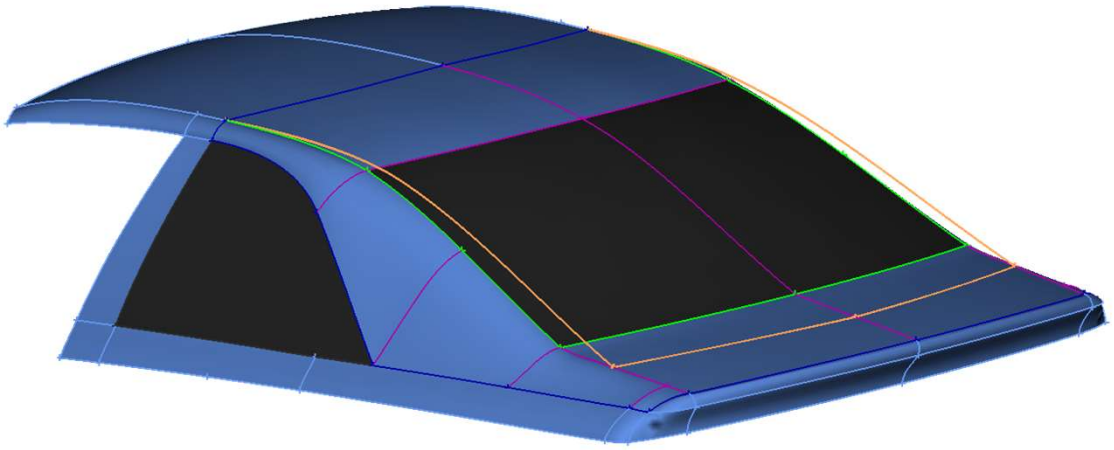
Snap FE or **geometry** edges to single or **multiple** target curves



Direct Morphing

DFM

Snap FE or **geometry** edges to single or **multiple** target curves

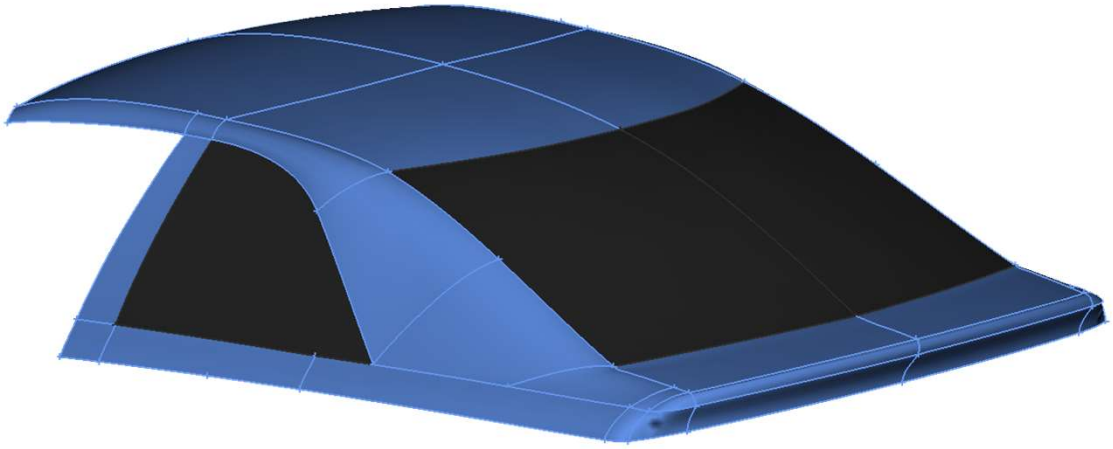


- Origin
- Target
- Morphed Entities
- Boundary

Direct Morphing

DFM

Snap FE or **geometry** edges to single or **multiple** target curves

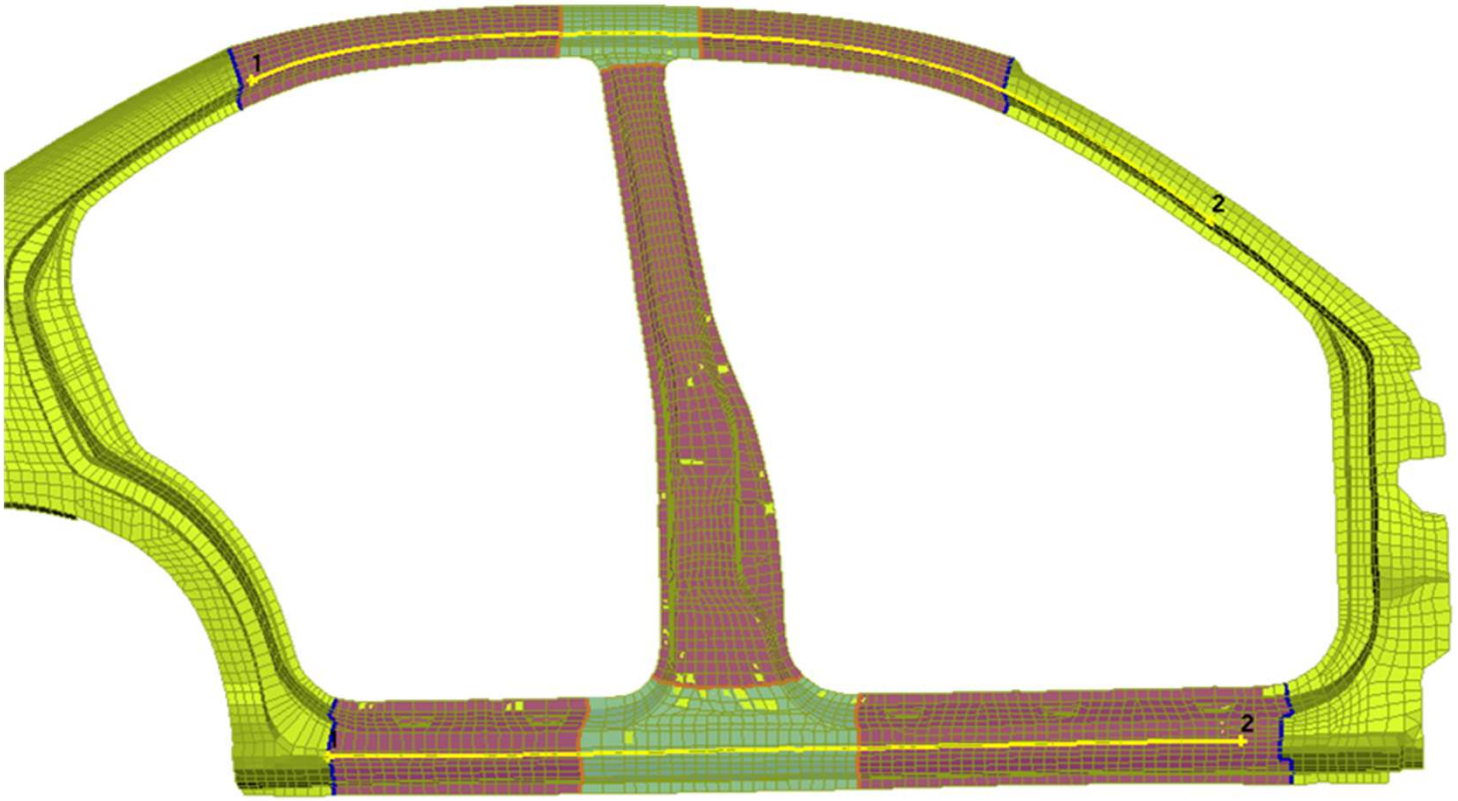


- Origin
- Target
- Morphed Entities
- Boundary
- Morphing

Direct Morphing

DFM

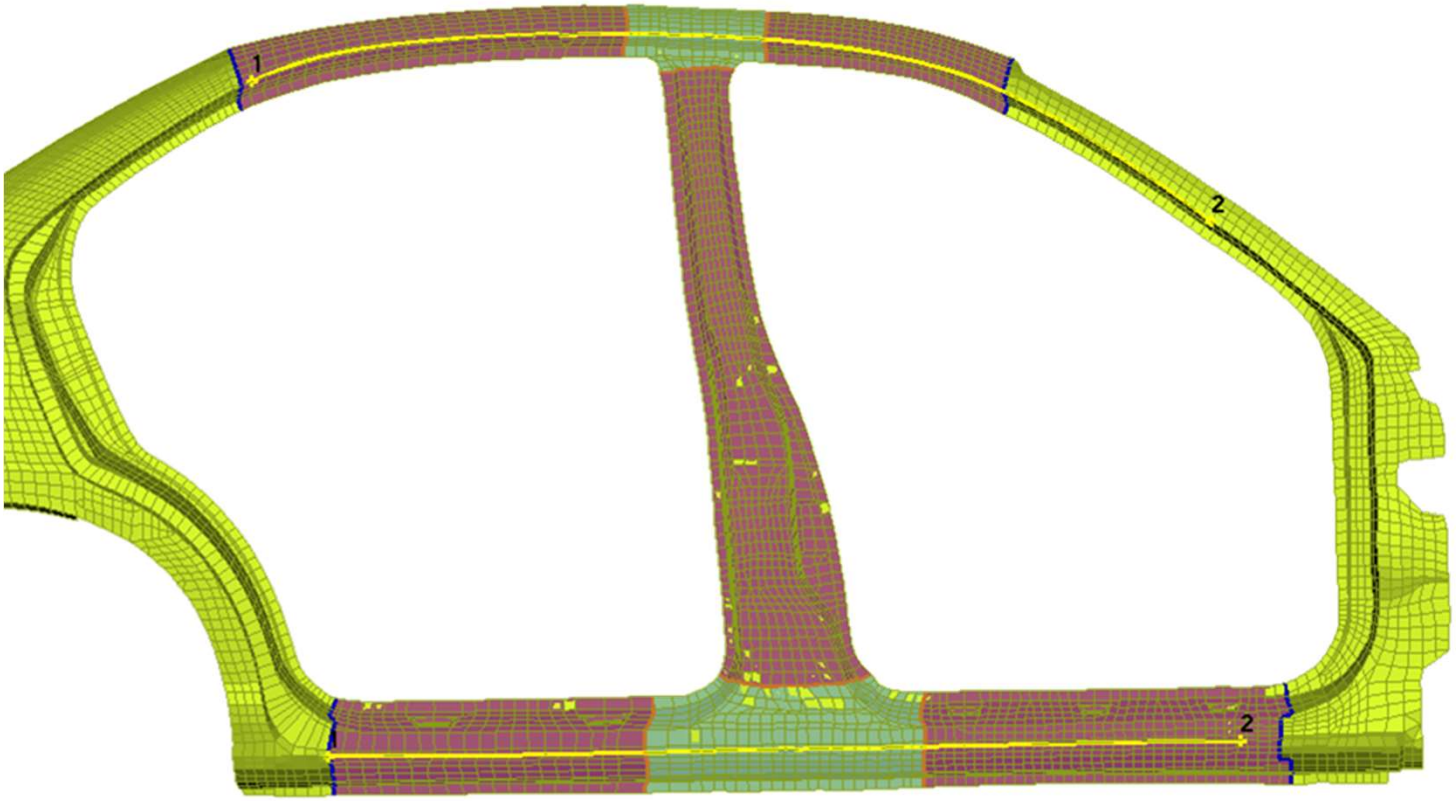
Sweep / Glide along pre-defined curves



Direct Morphing

DFM

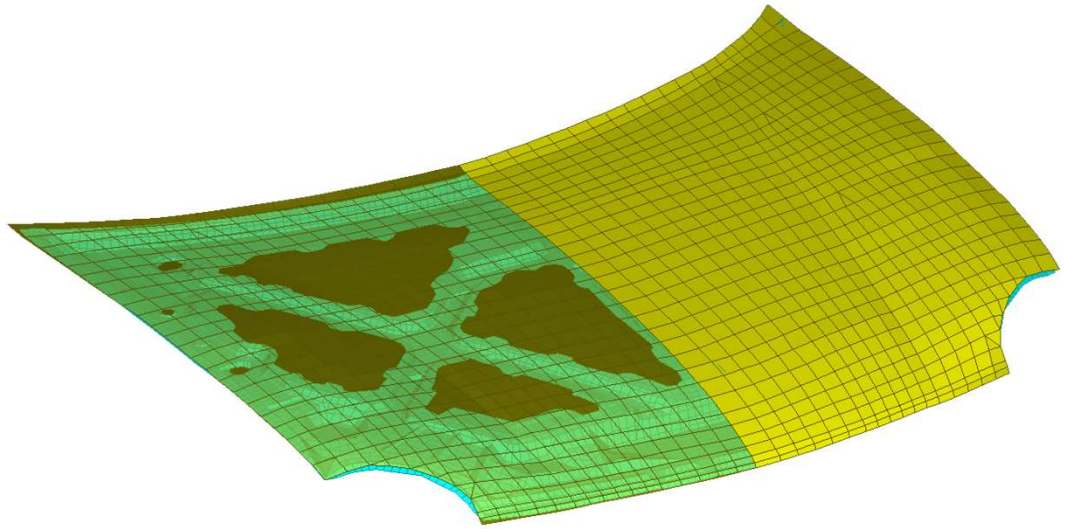
Sweep / Glide along pre-defined curves



Direct Morphing

DFM

Surface Fit of **initial FE** or geometry onto **target** FE or **geometry**

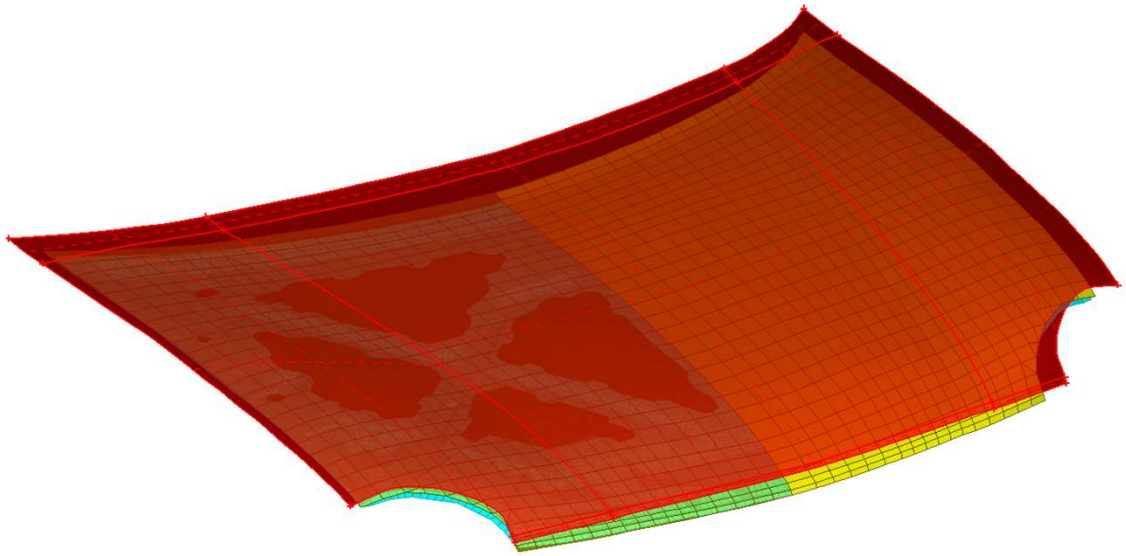


- Initial FE-surface (with additional underlying parts)

Direct Morphing

DFM

Surface Fit of **initial FE** or geometry onto **target** FE or **geometry**

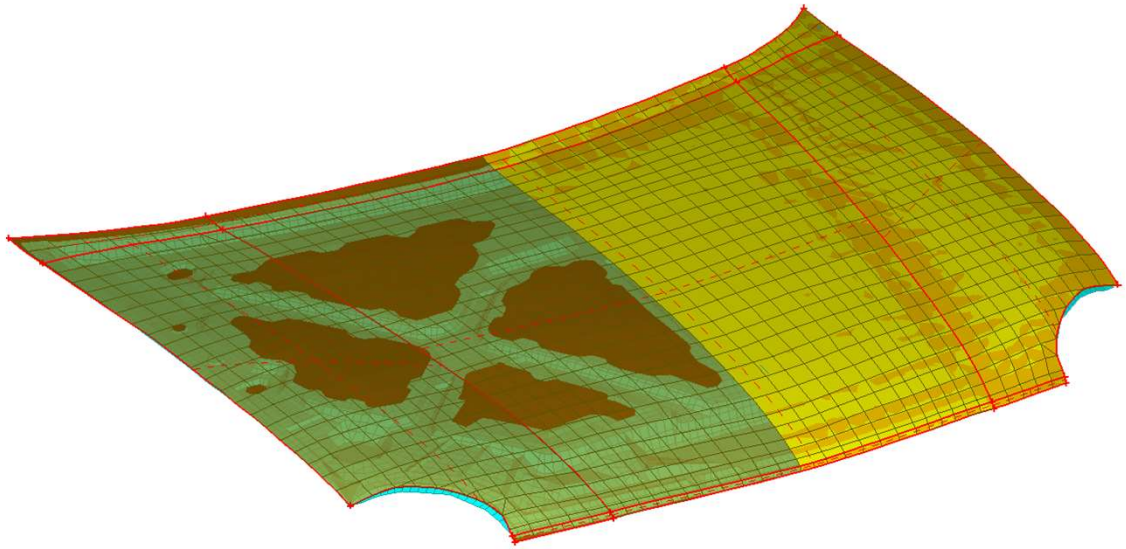


- Initial FE-surface (with additional underlying parts)
- Target CAD-surface

Direct Morphing

DFM

Surface Fit of **initial FE** or geometry onto **target** FE or **geometry**

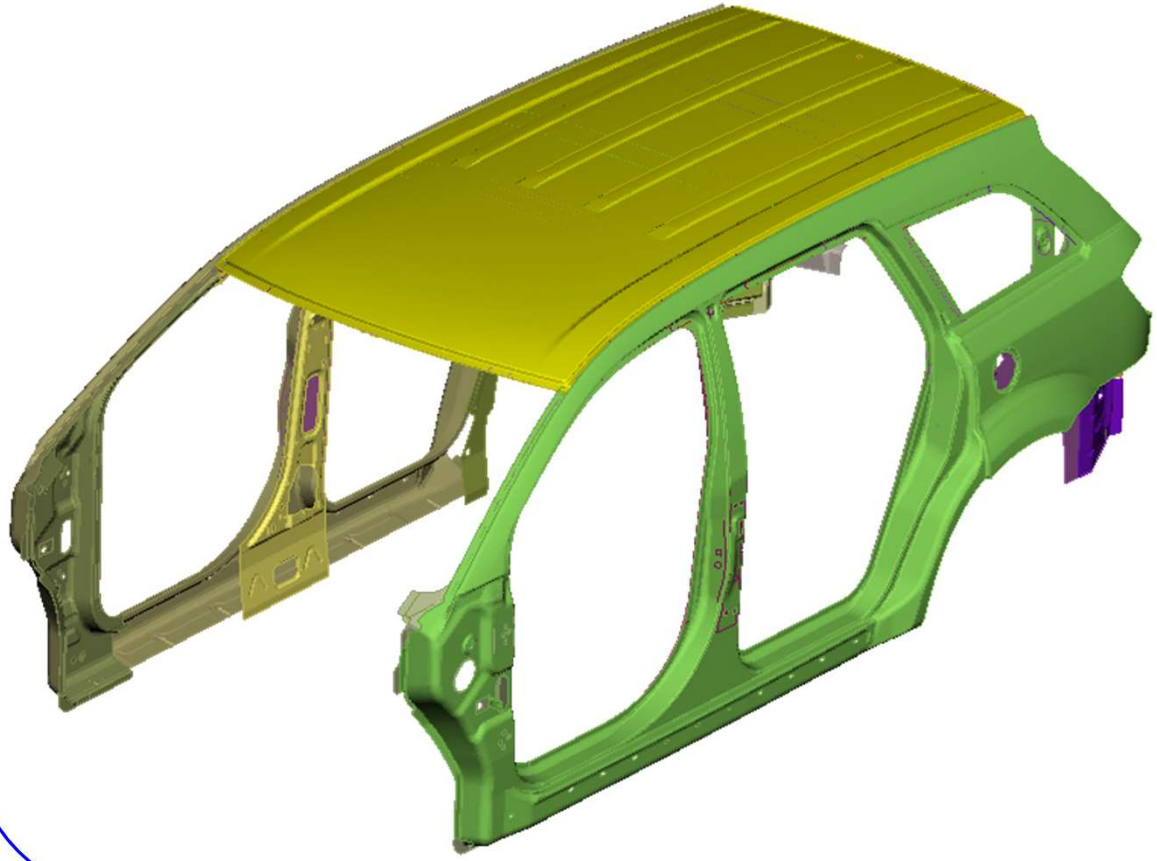


- Initial FE-surface (with additional underlying parts)
- Target CAD-surface
- Morphing

Direct Morphing

DFM

Surface Fit of **initial FE** or geometry onto **target FE** or geometry

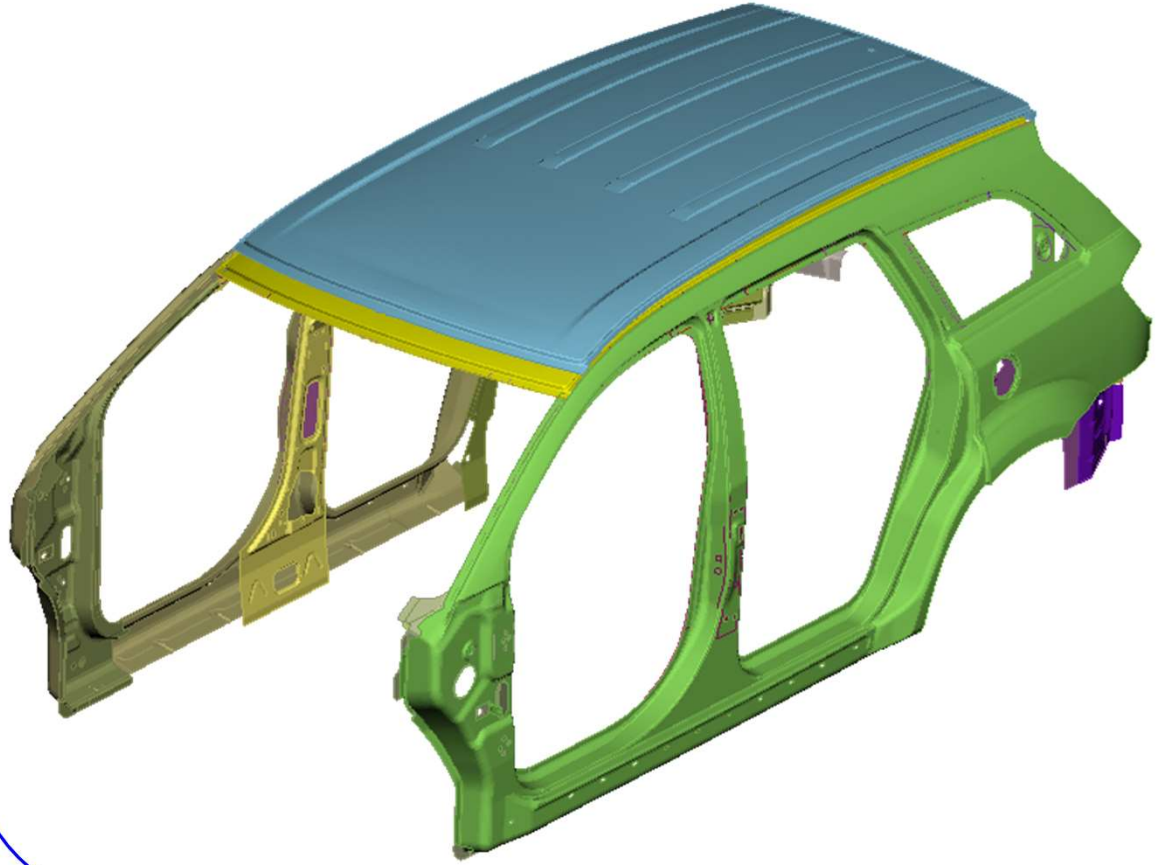


- Initial FE-surface

Direct Morphing

DFM

Surface Fit of **initial FE** or geometry onto **target FE** or geometry

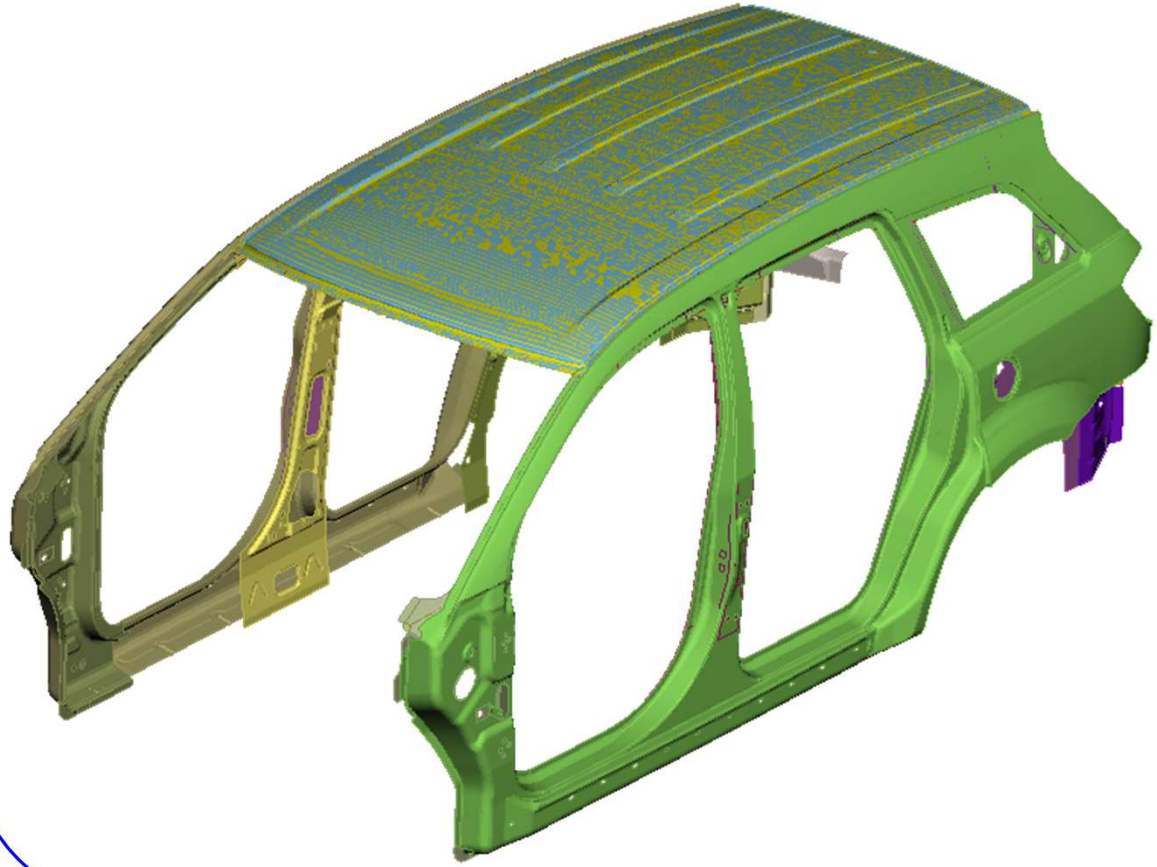


- Initial FE-surface
- Target FE-surface

Direct Morphing

DFM

Surface Fit of **initial FE** or geometry onto **target FE** or geometry

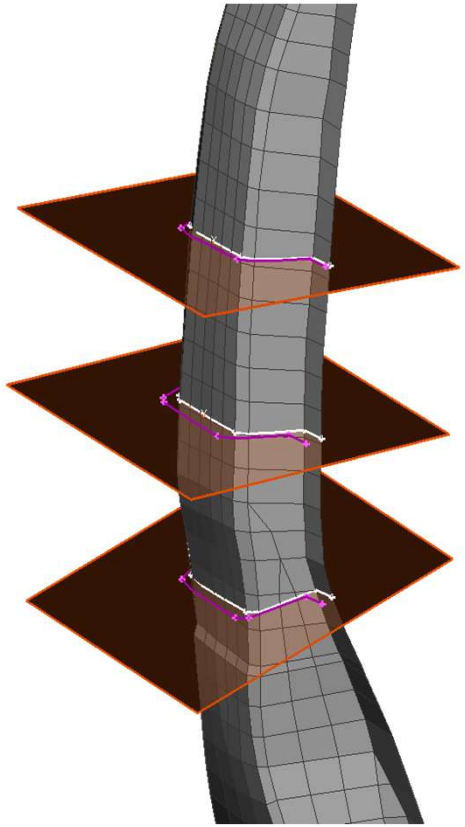


- Initial FE-surface
- Target FE-surface
- Morphing

Direct Morphing

Cross Sections

Fit cross sections (applicable on FE-mesh and geometry)

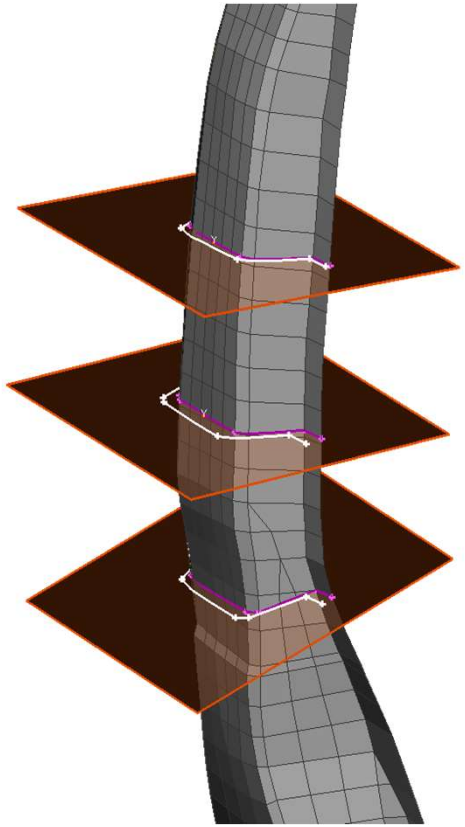


- Original cross section

Direct Morphing

Cross Sections

Fit cross sections (applicable on FE-mesh and geometry)

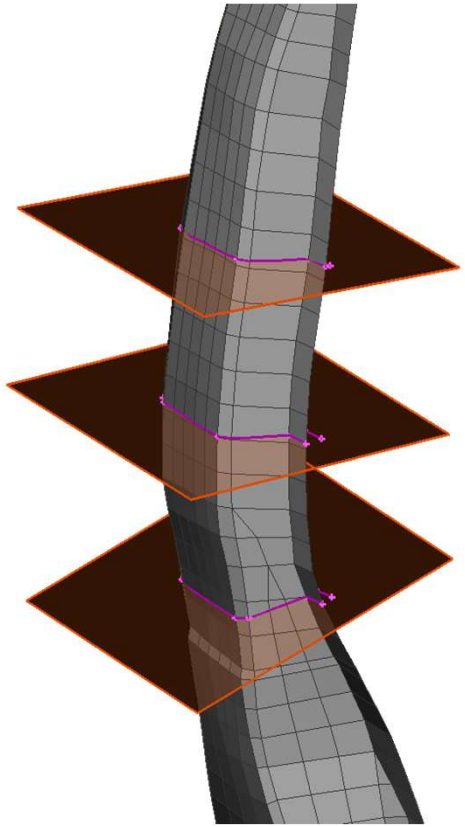


- Original cross section
- Target cross section

Direct Morphing

Cross Sections

Fit cross sections (applicable on FE-mesh and geometry)

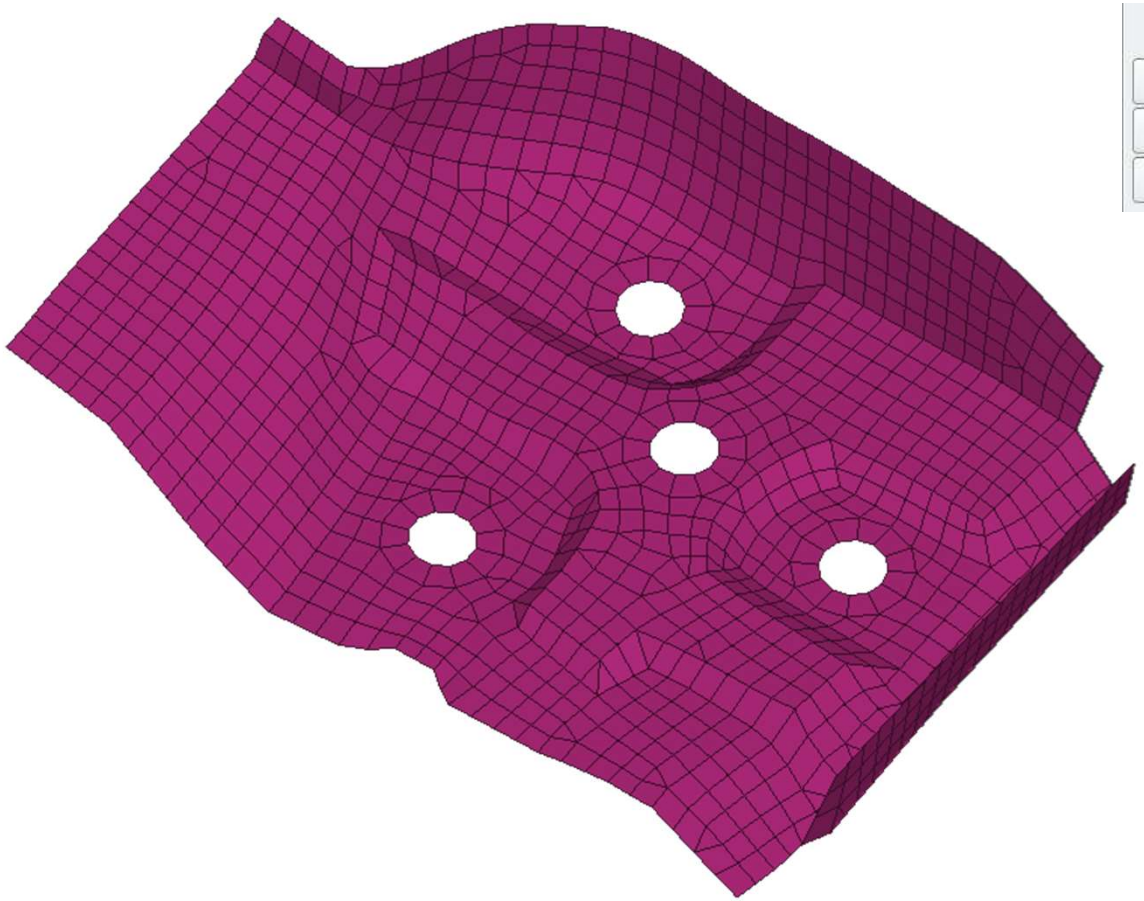


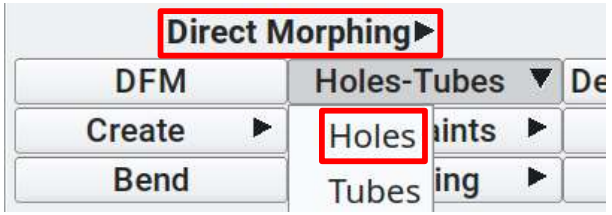
- Original cross section
- Target cross section
- Morphing

Direct Morphing

2D & 3D Holes

Manipulate diameter of **2D Holes**

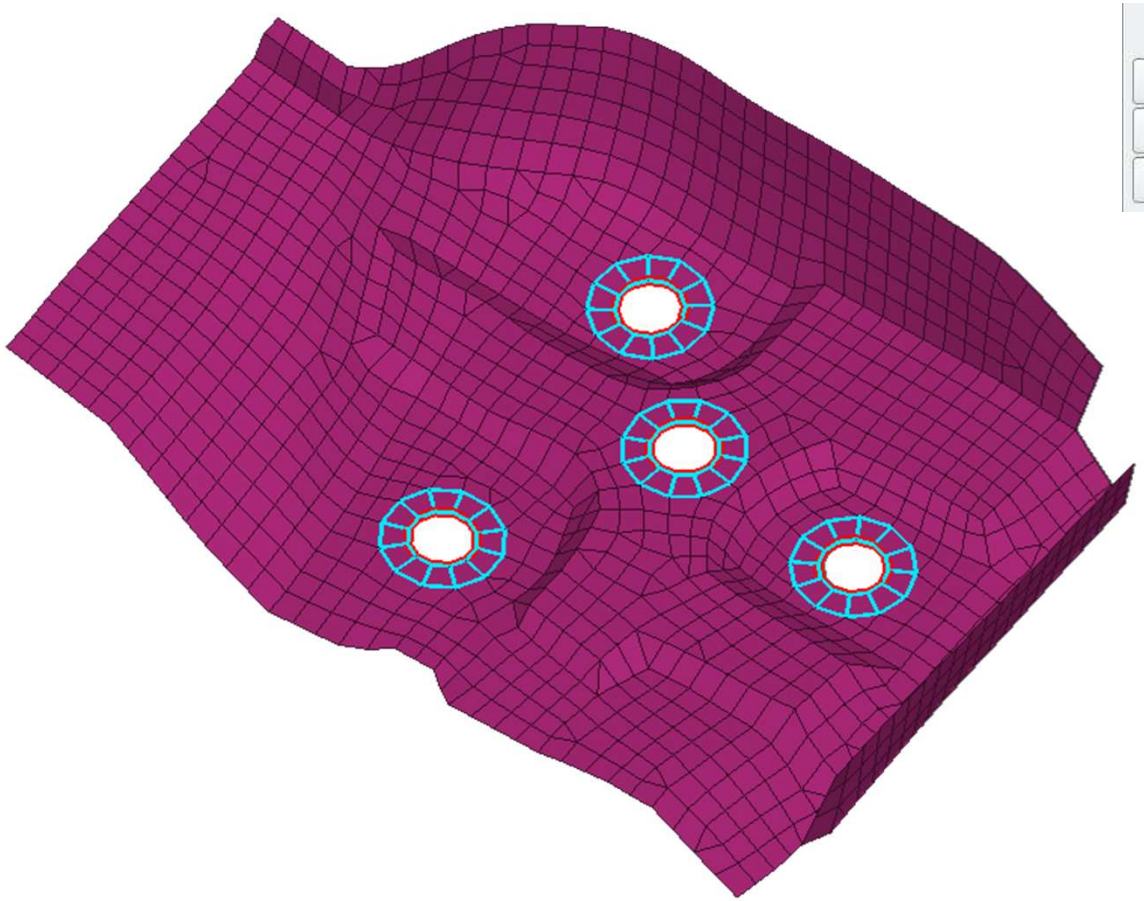


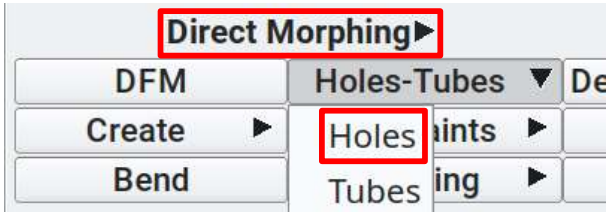


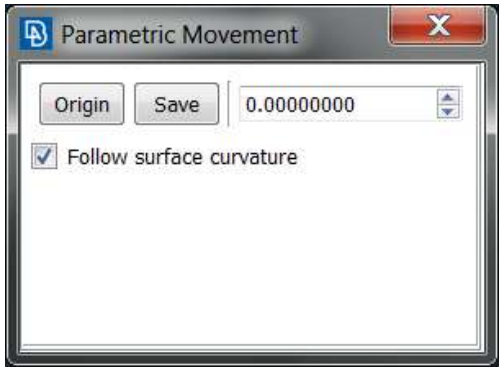
Direct Morphing

2D & 3D Holes

Manipulate diameter of **2D Holes**



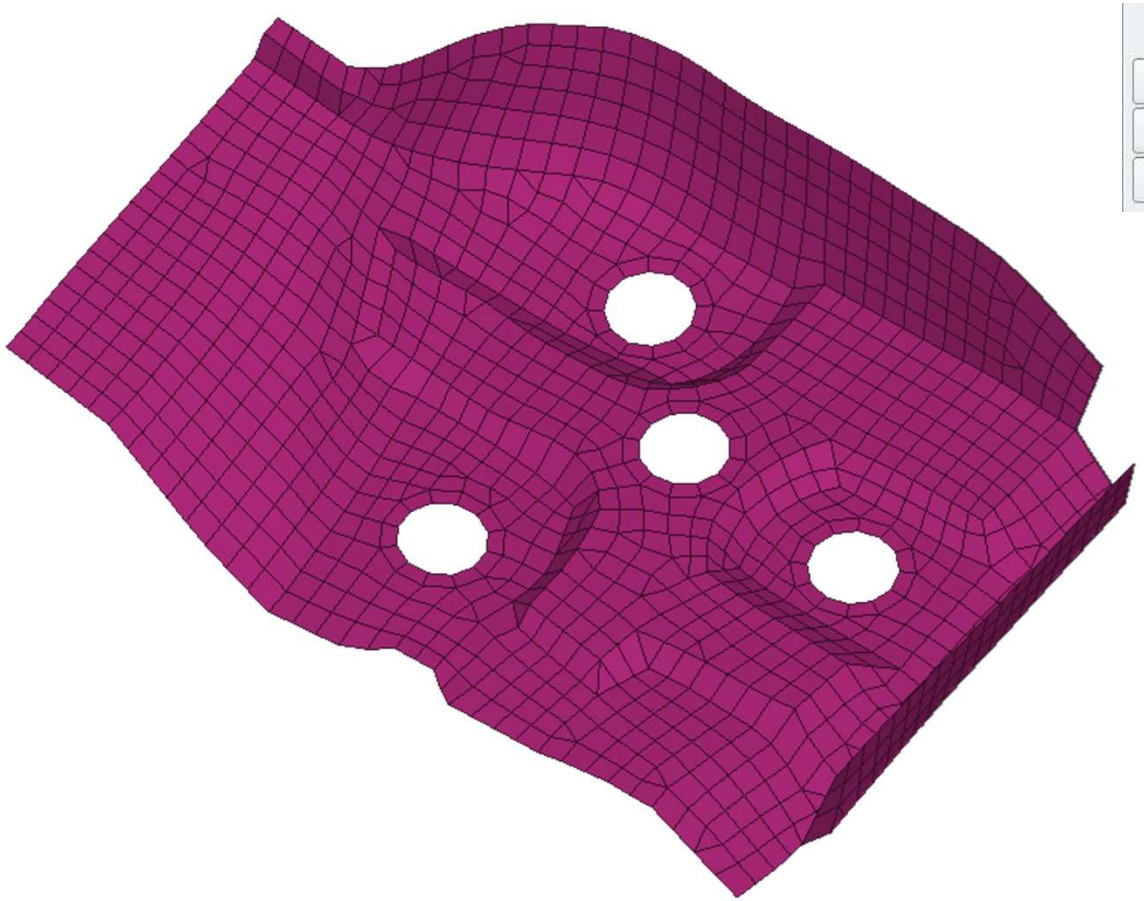


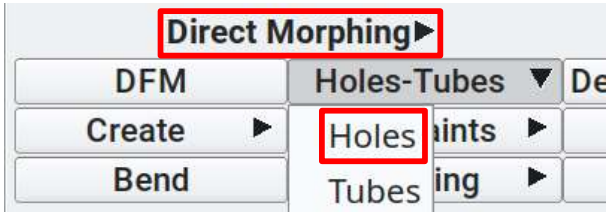


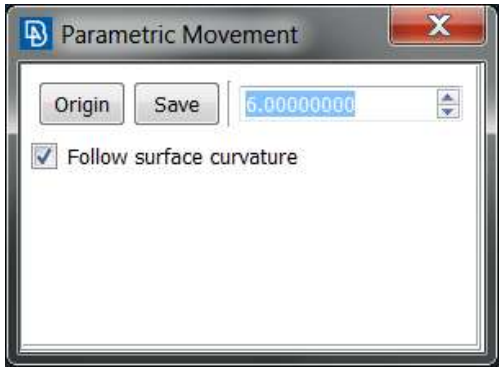
Direct Morphing

2D & 3D Holes

Manipulate diameter of **2D Holes**



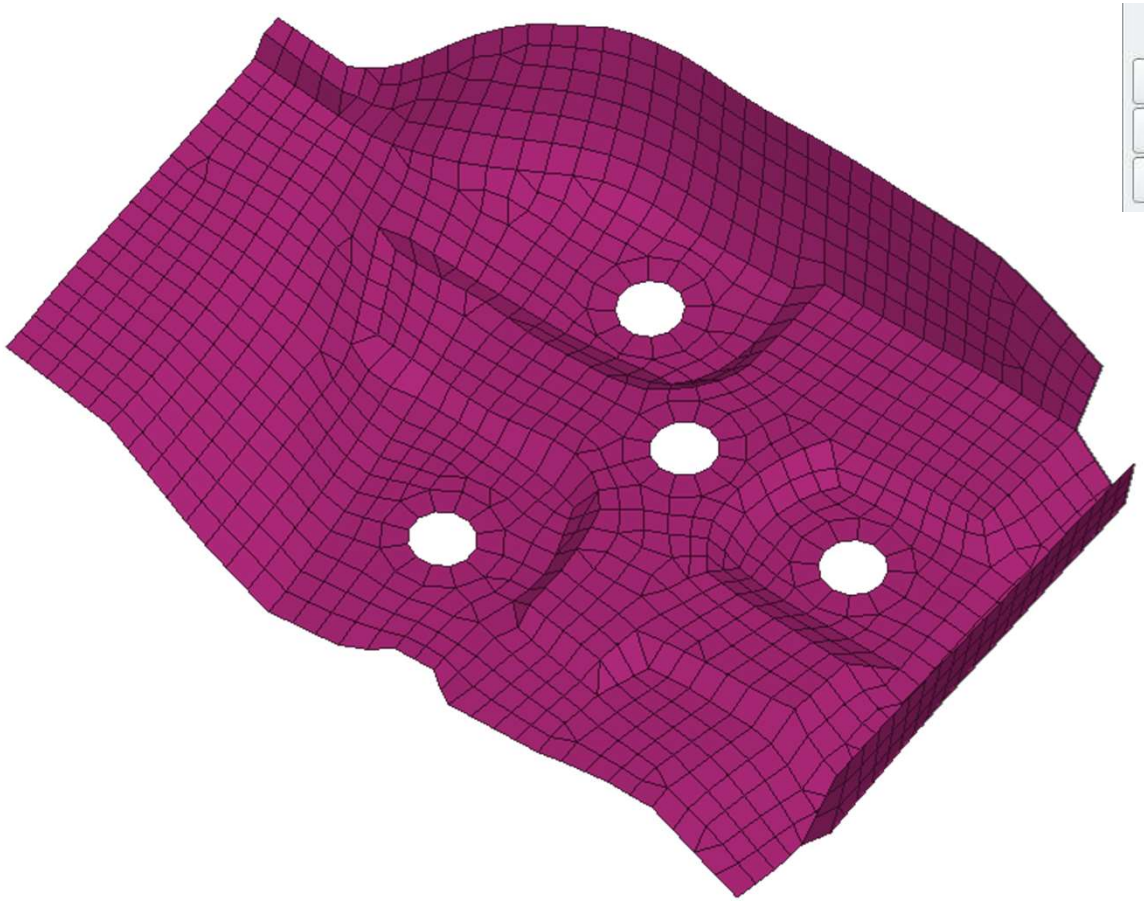


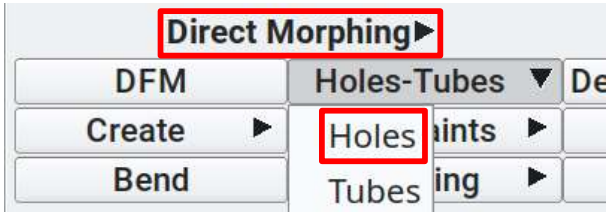


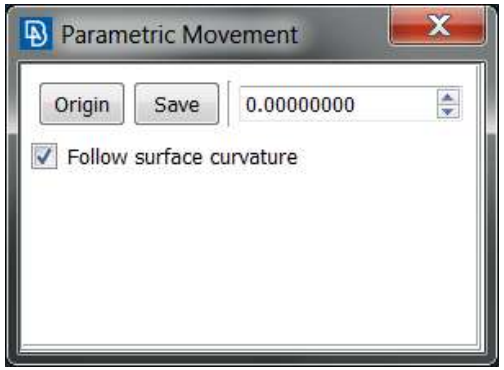
Direct Morphing

2D & 3D Holes

Manipulate diameter of **2D Holes**



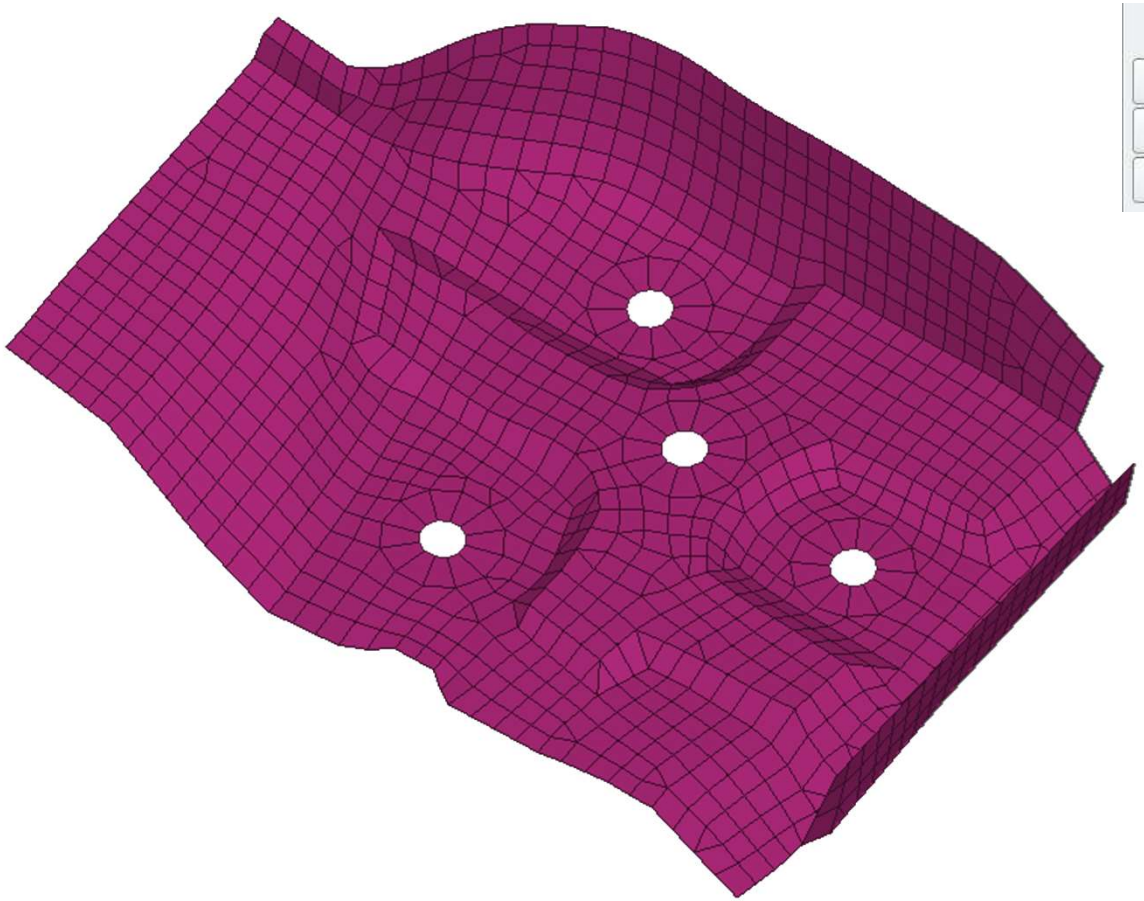


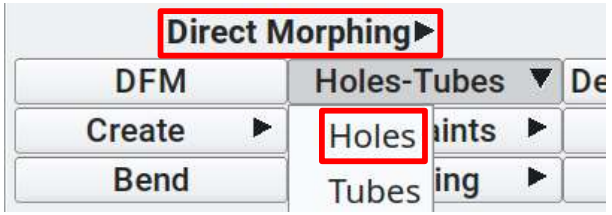


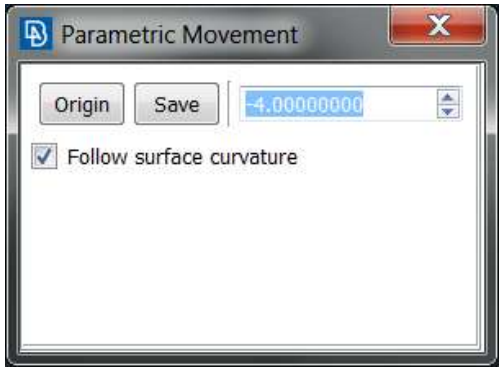
Direct Morphing

2D & 3D Holes

Manipulate diameter of **2D Holes**



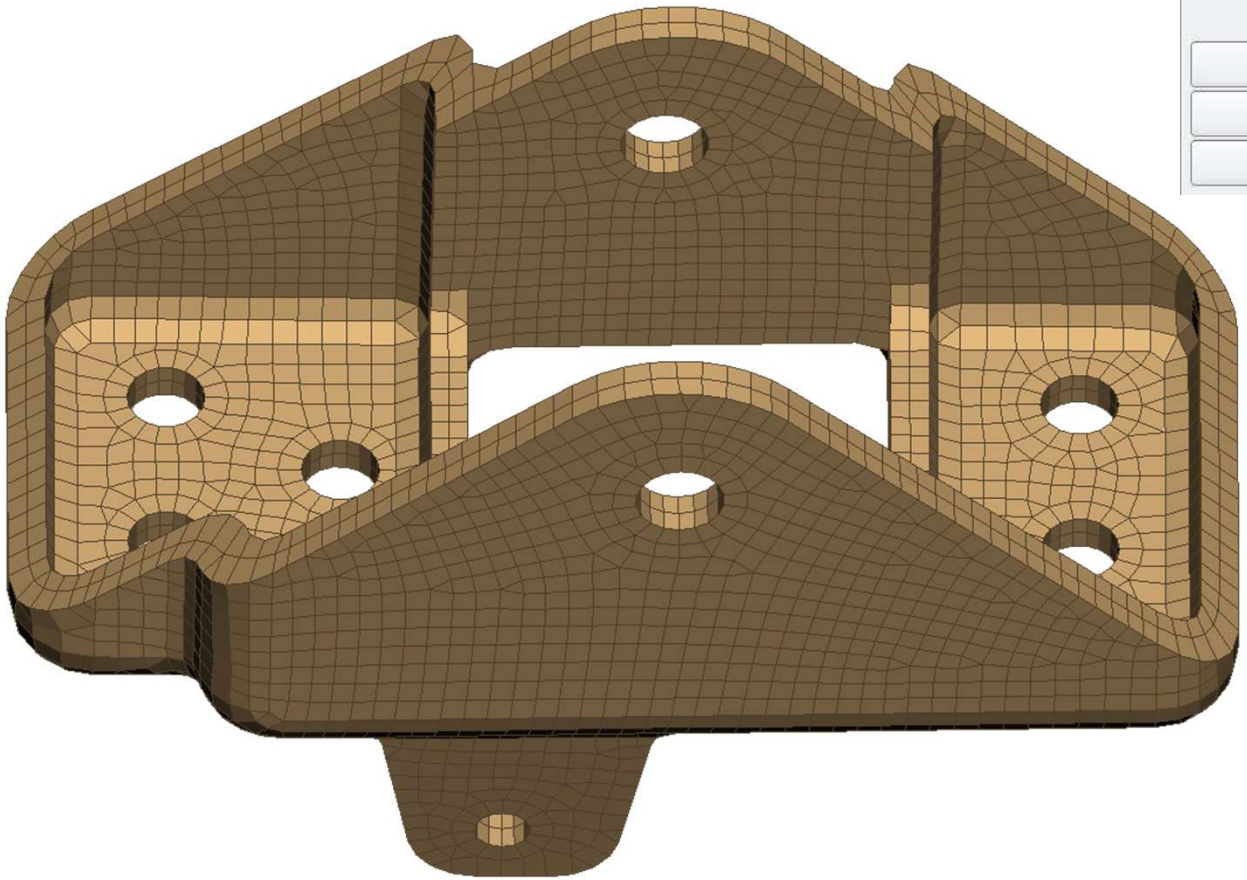


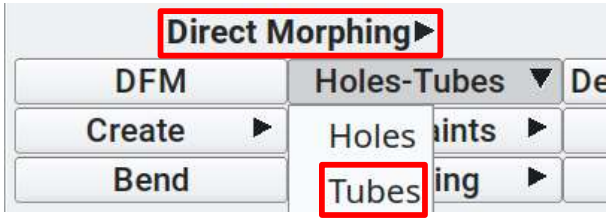


Direct Morphing

2D & 3D Holes

Manipulate diameter of **3D Holes**

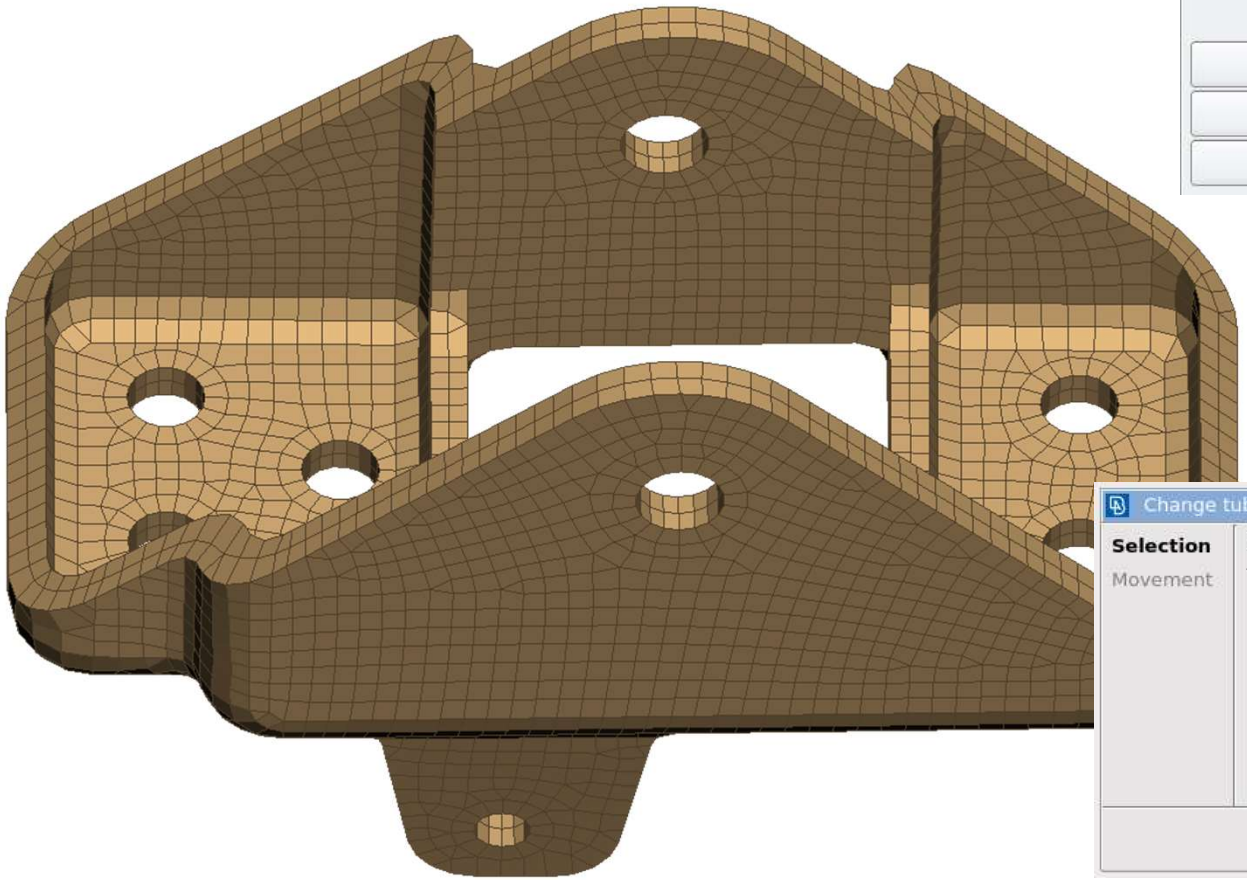


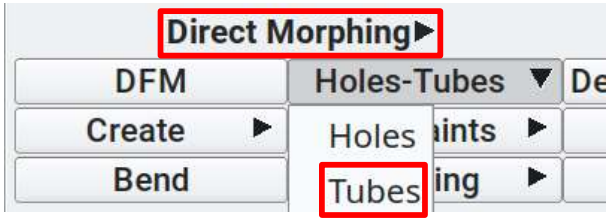


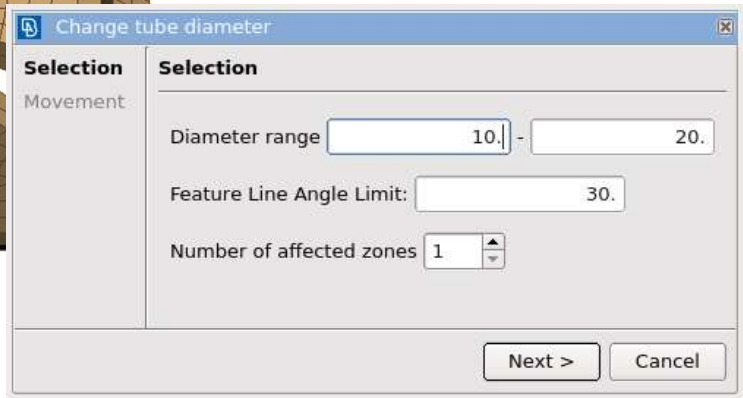
Direct Morphing

2D & 3D Holes

Manipulate diameter of **3D Holes**



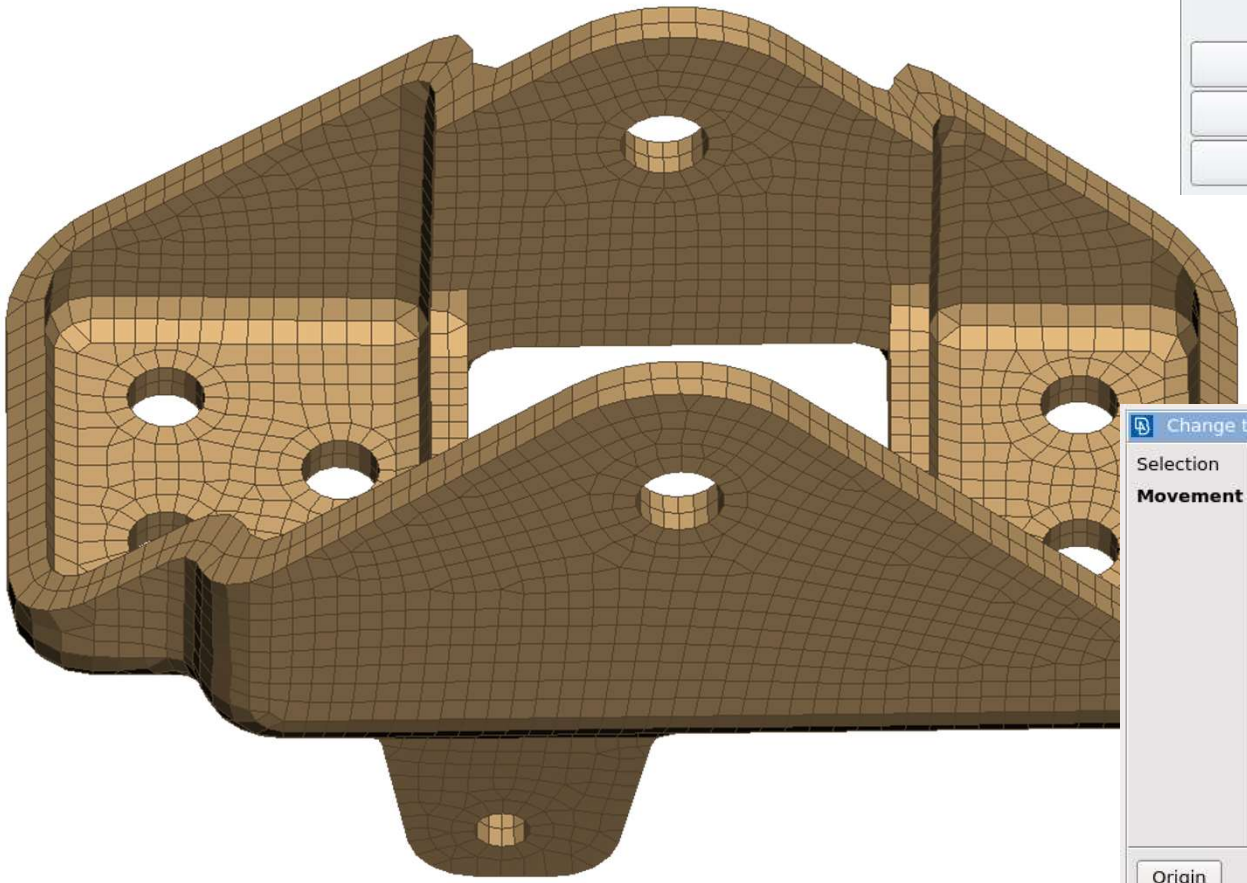


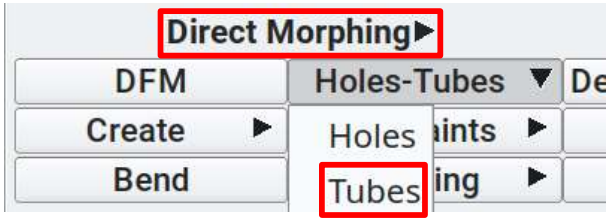


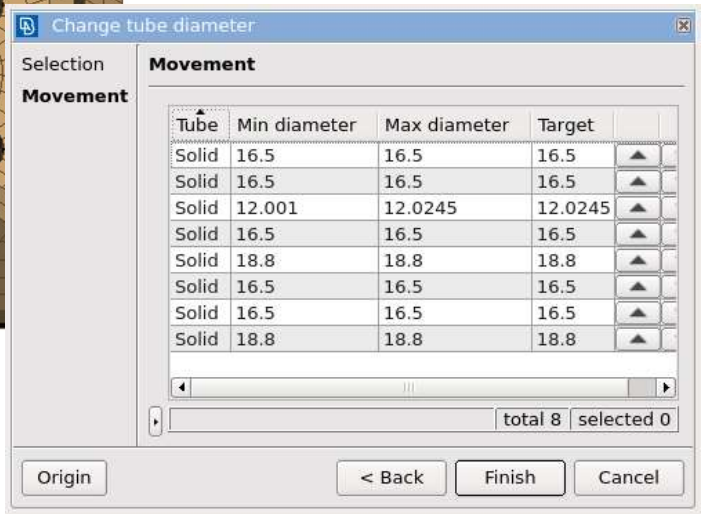
Direct Morphing

2D & 3D Holes

Manipulate diameter of **3D Holes**



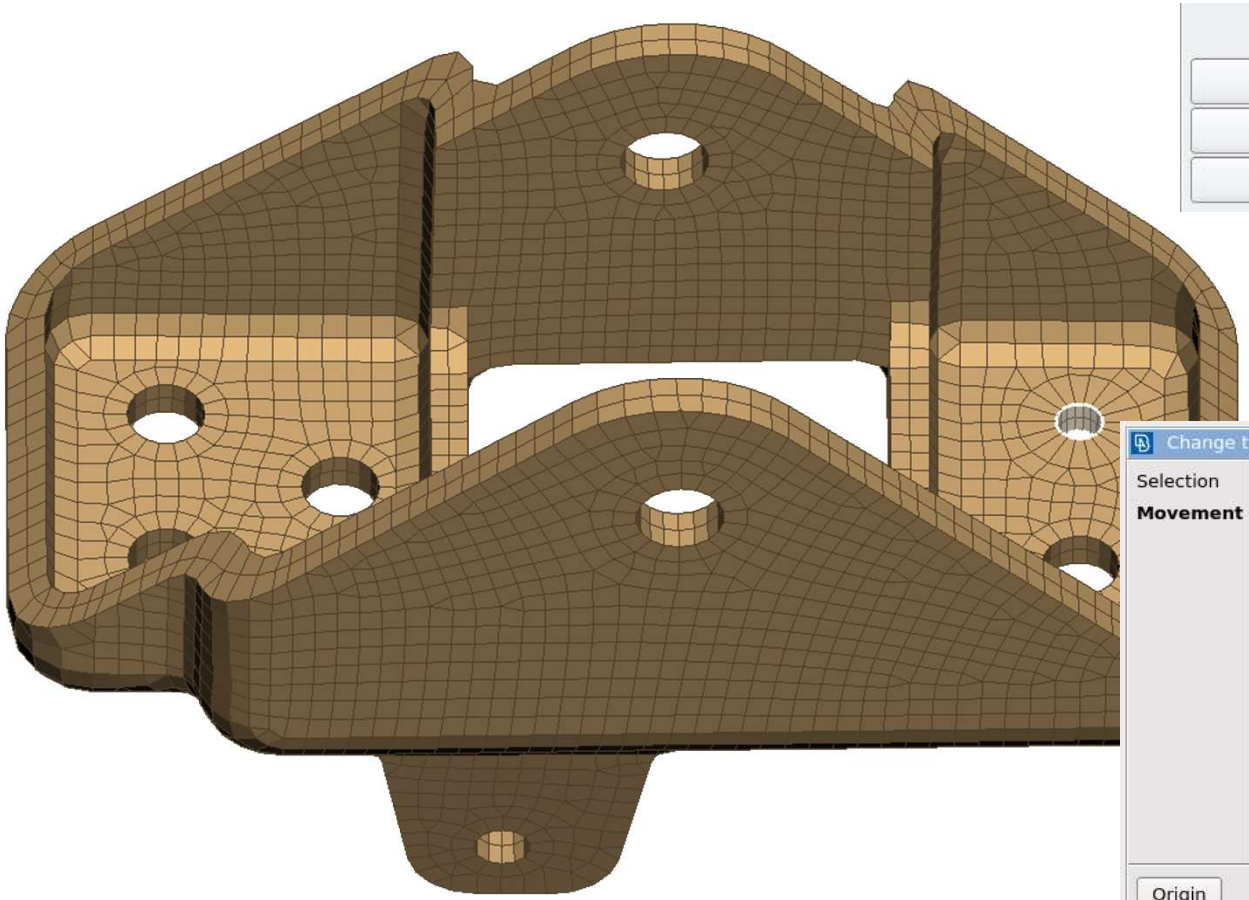


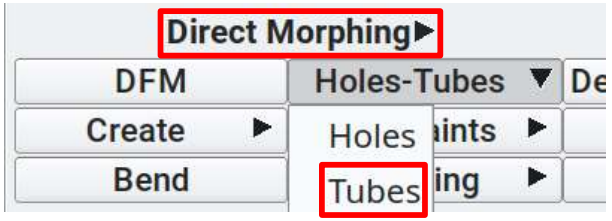


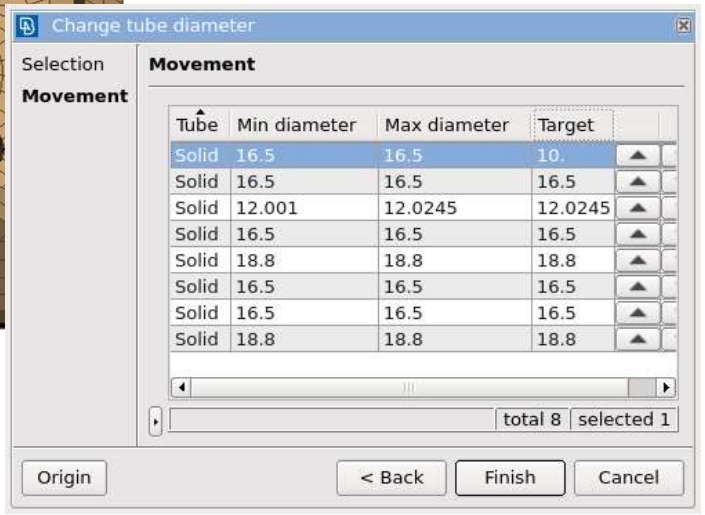
Direct Morphing

2D & 3D Holes

Manipulate diameter of **3D Holes**



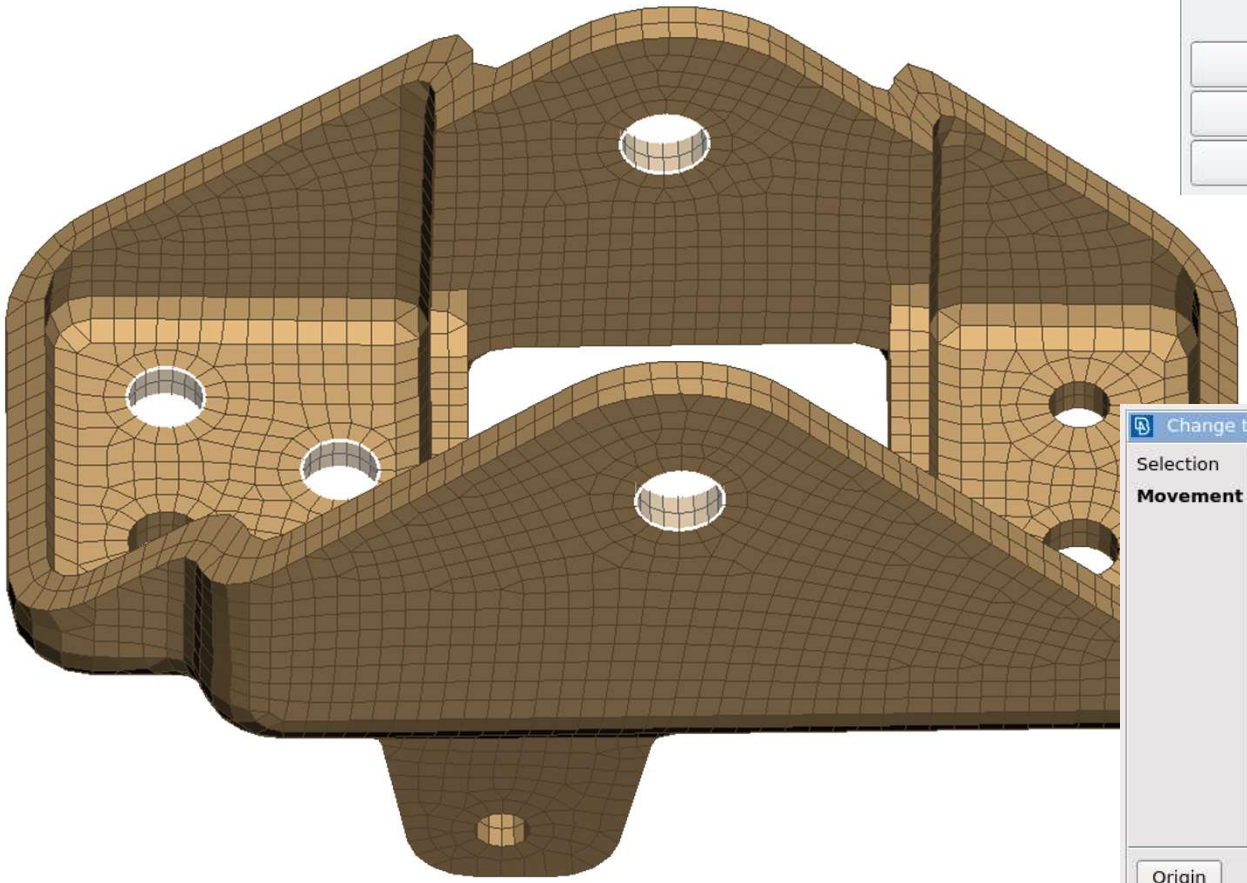


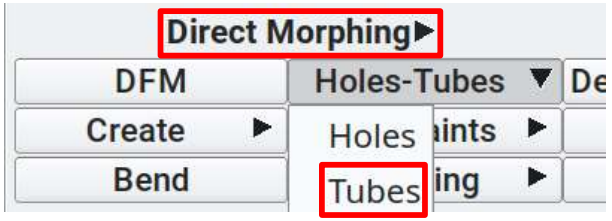


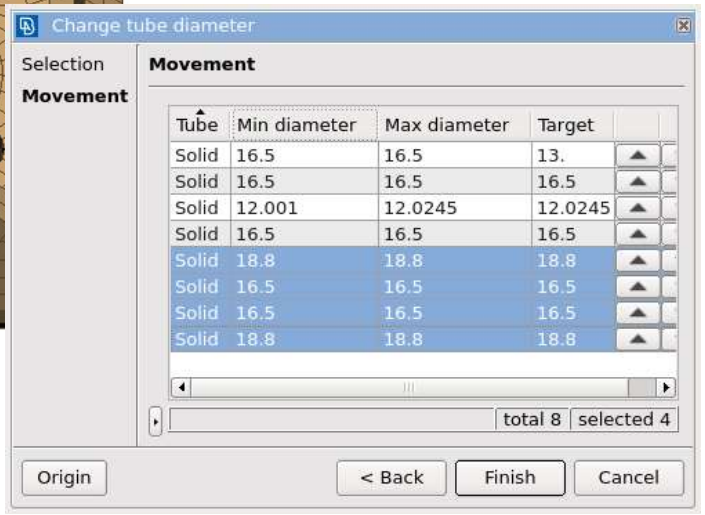
Direct Morphing

2D & 3D Holes

Manipulate diameter of **3D Holes**



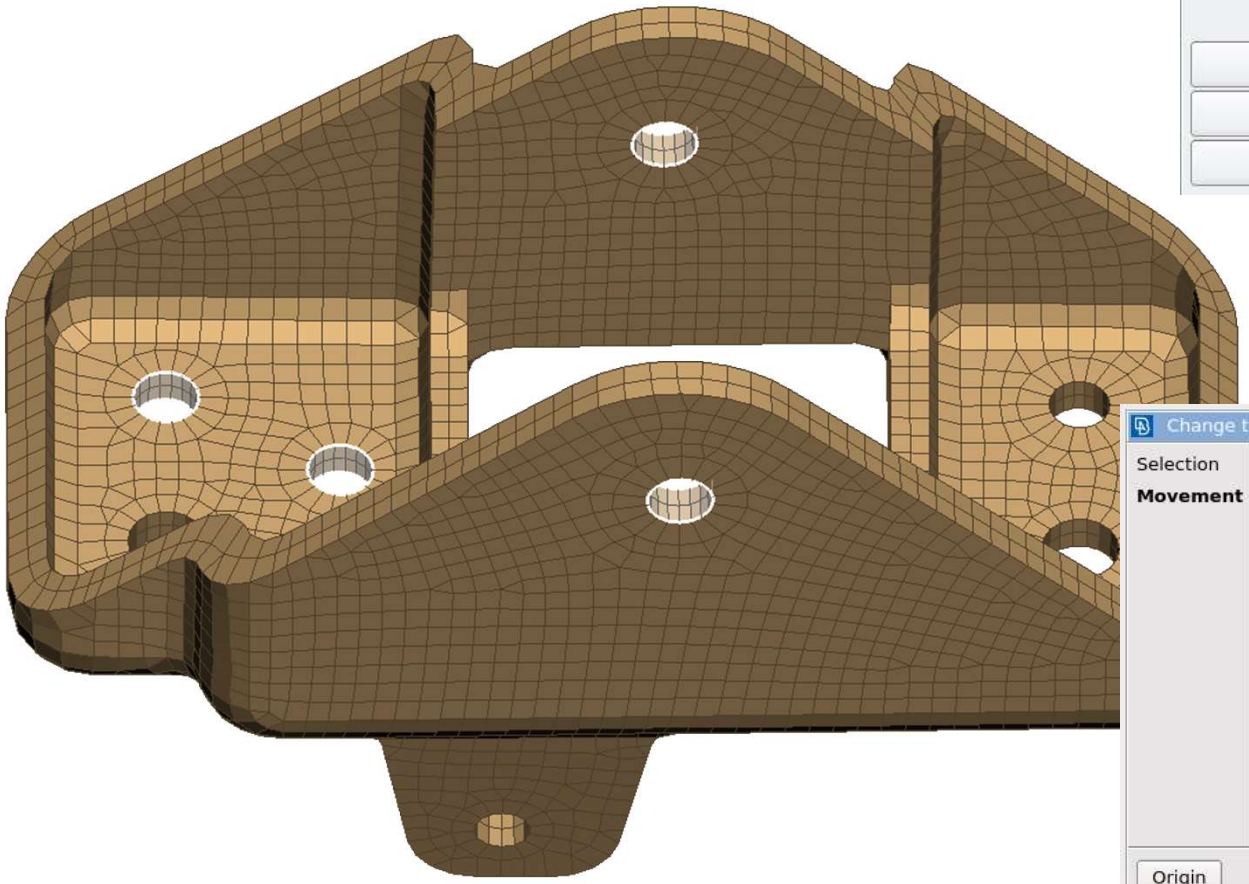


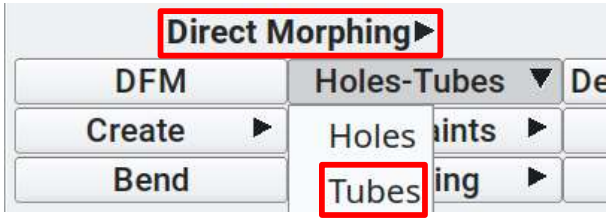


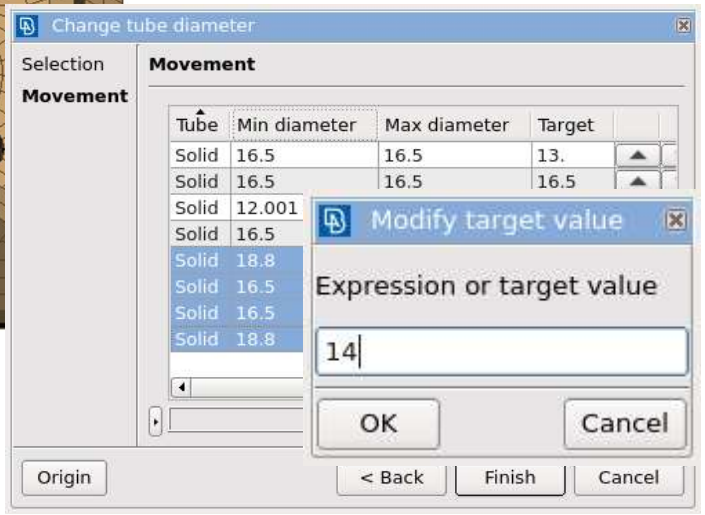
Direct Morphing

2D & 3D Holes

Manipulate diameter of **3D Holes**



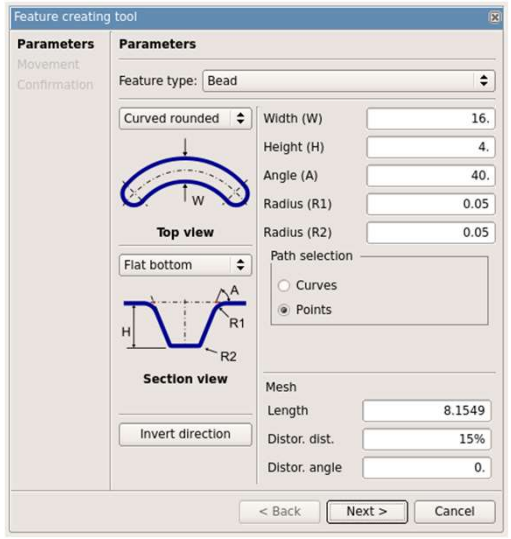


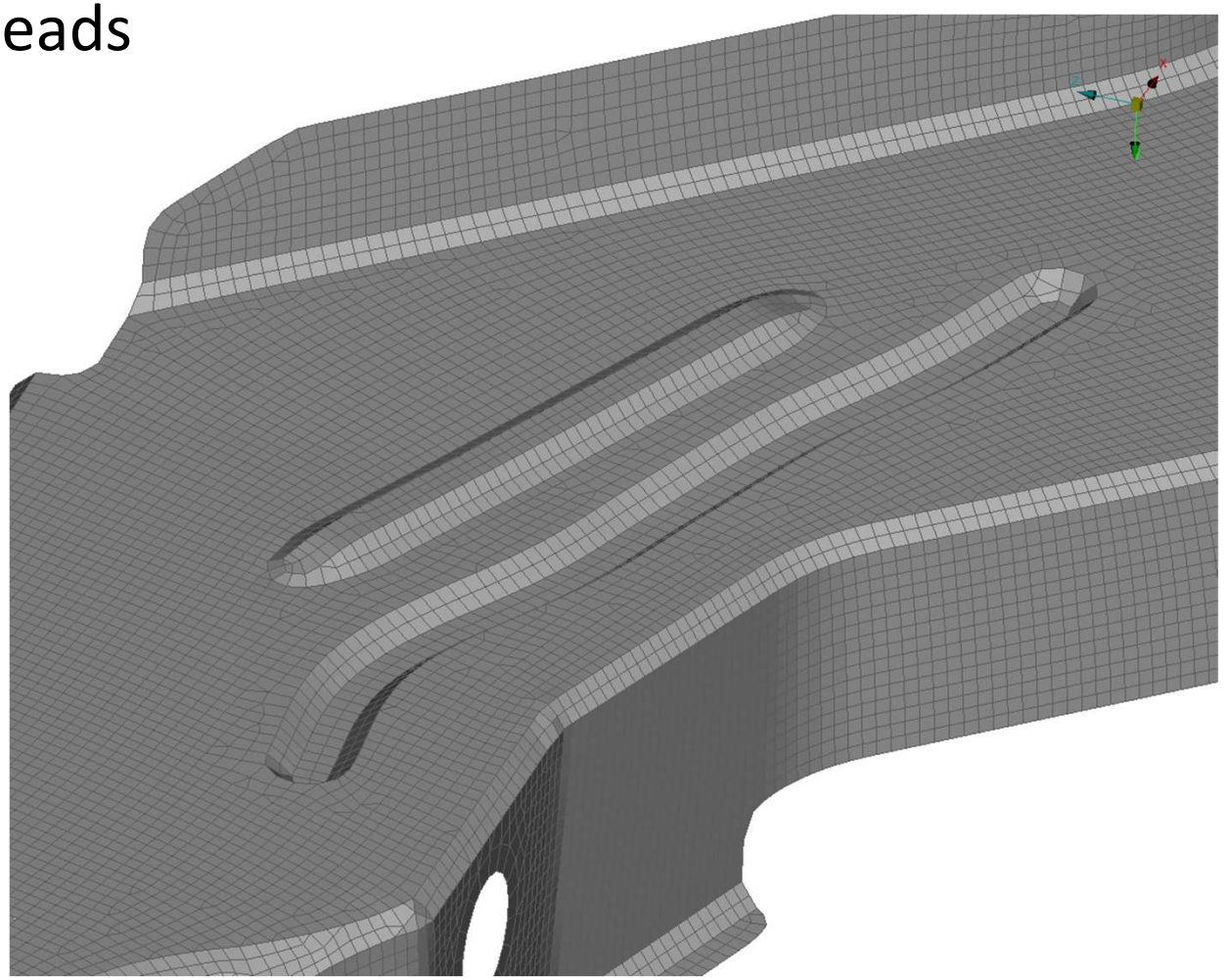


Direct Morphing

Generation & modification of beads and embosses

- Curved & Rounded Beads

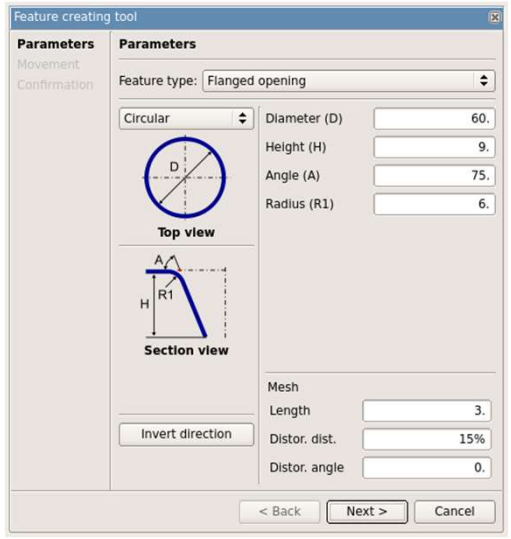


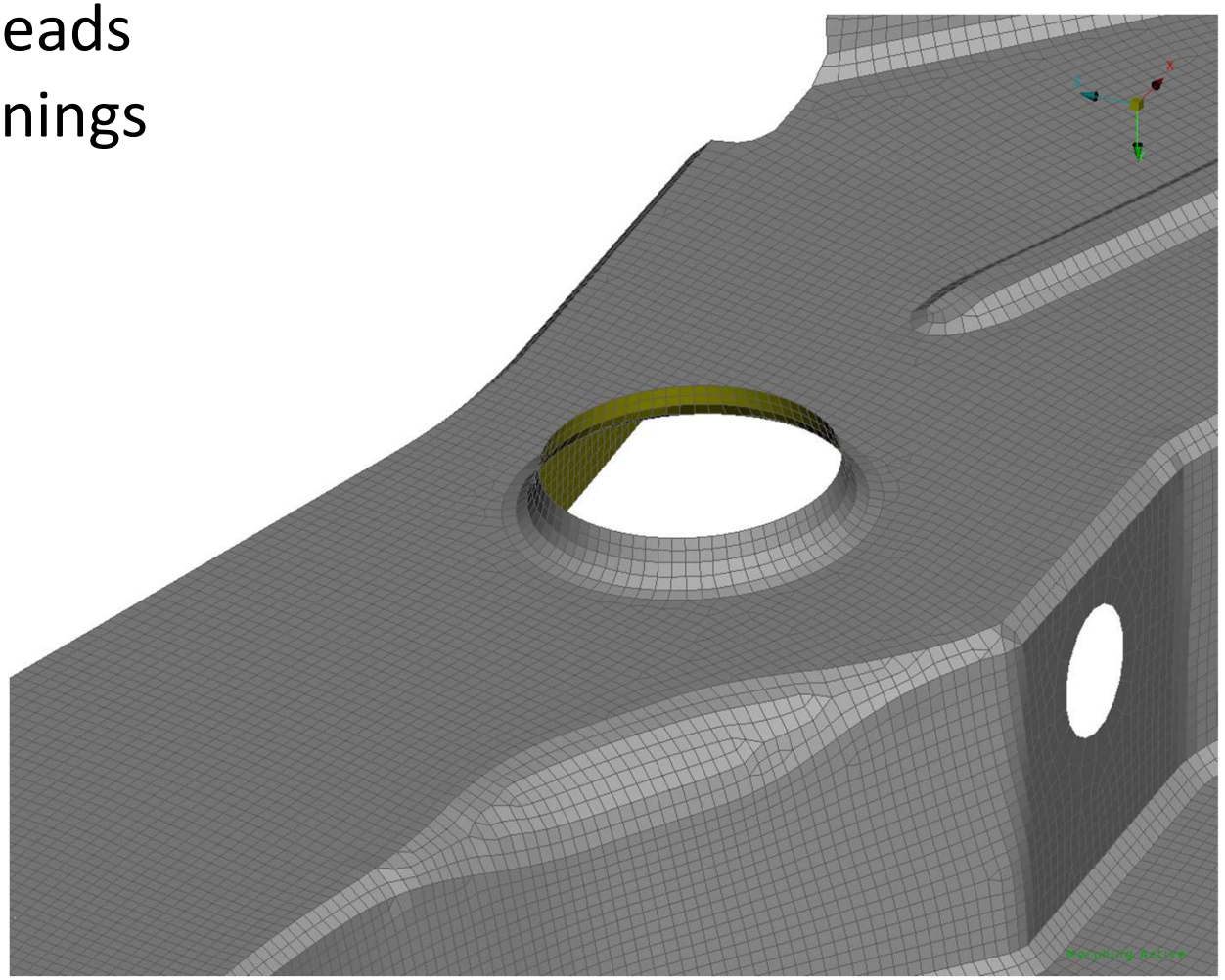


Direct Morphing

Generation & modification of beads and embosses

- Curved & Rounded Beads
- Circular Flanged Openings

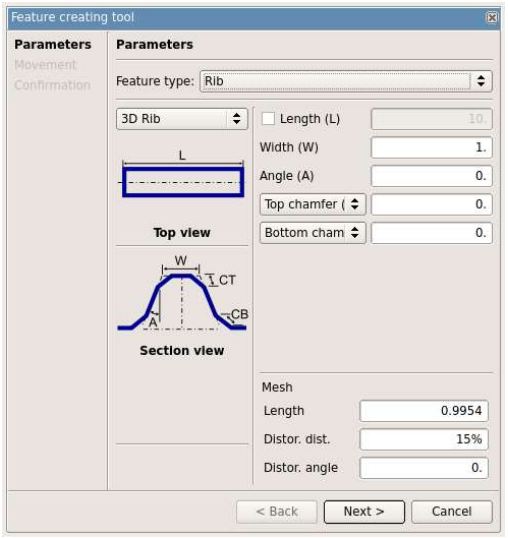


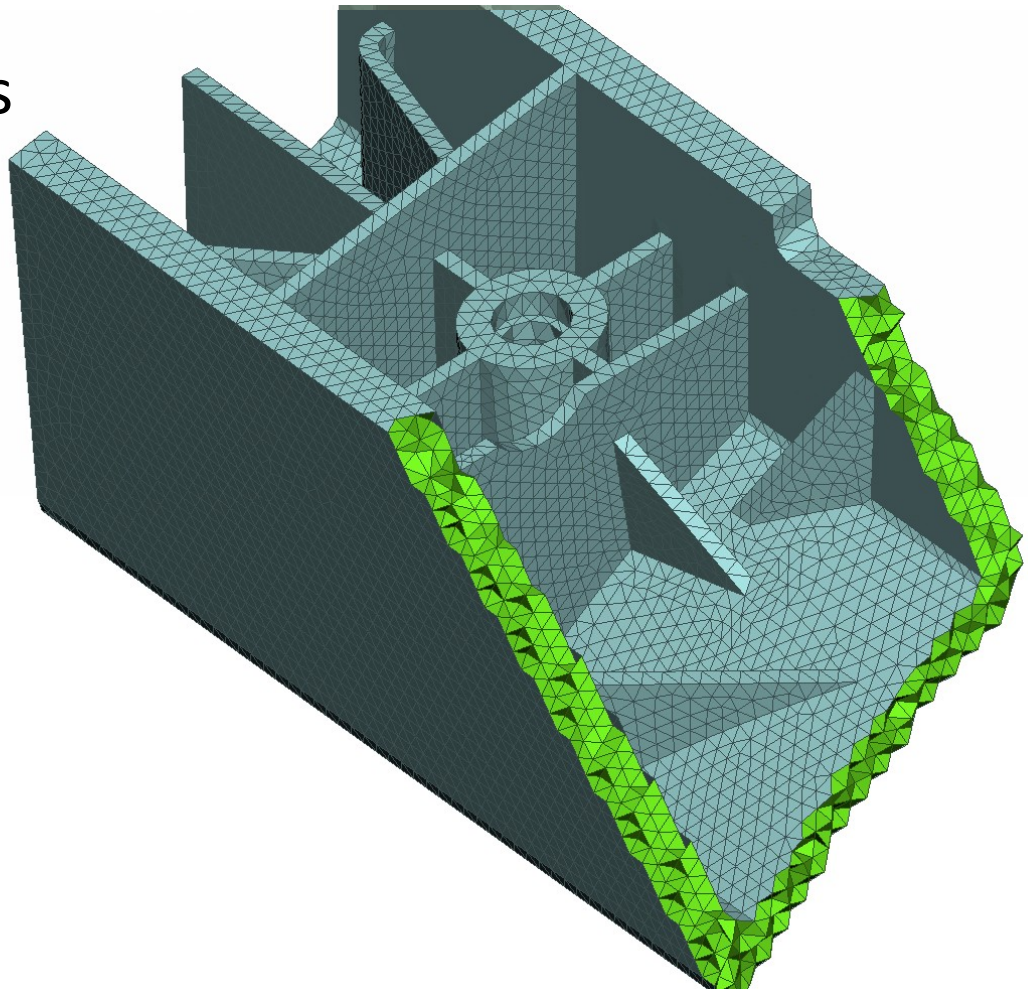


Direct Morphing

Generation & modification of beads and embosses

- Curved & Rounded Beads
- Circular Flanged Openings
- Shell or Solid Ribs

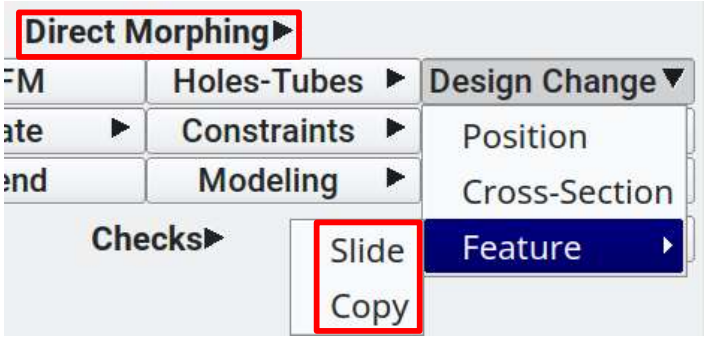


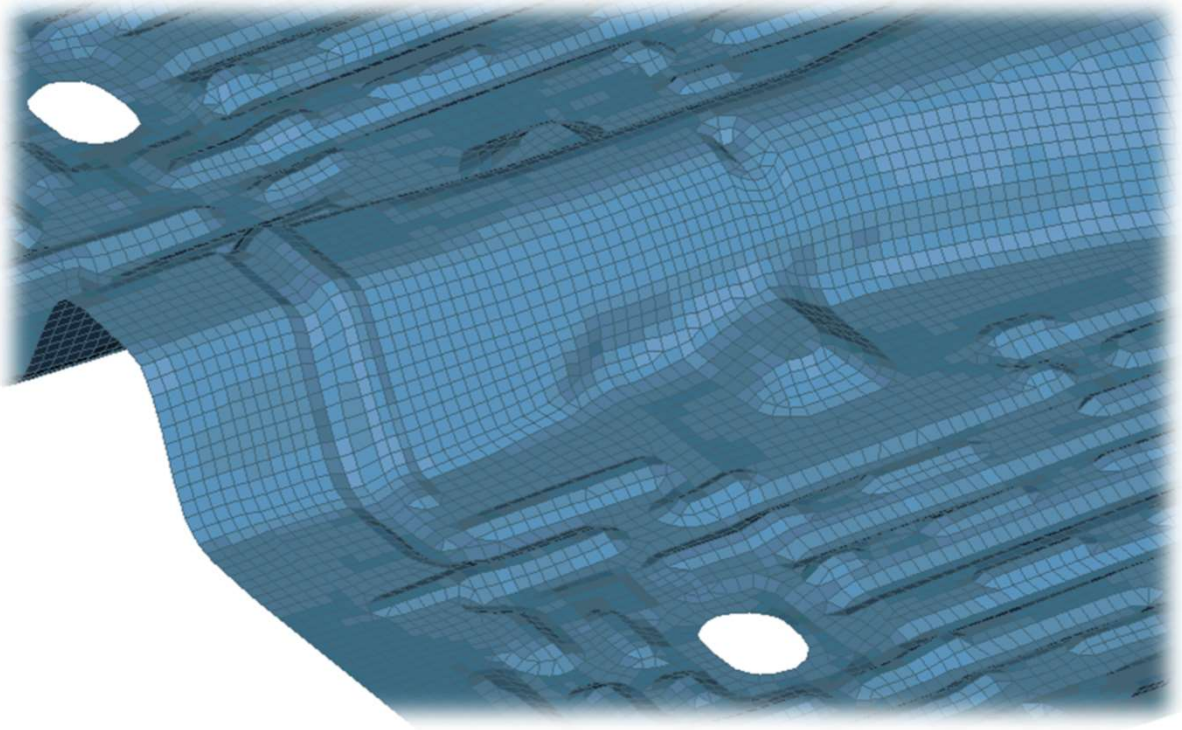


Direct Morphing

Design Change: Feature Slide/Copy

- Features of any shape (e.g. holes, beads, ribs) can be moved or copied on underlying surface
- Mesh of origin and target areas is reconstructed

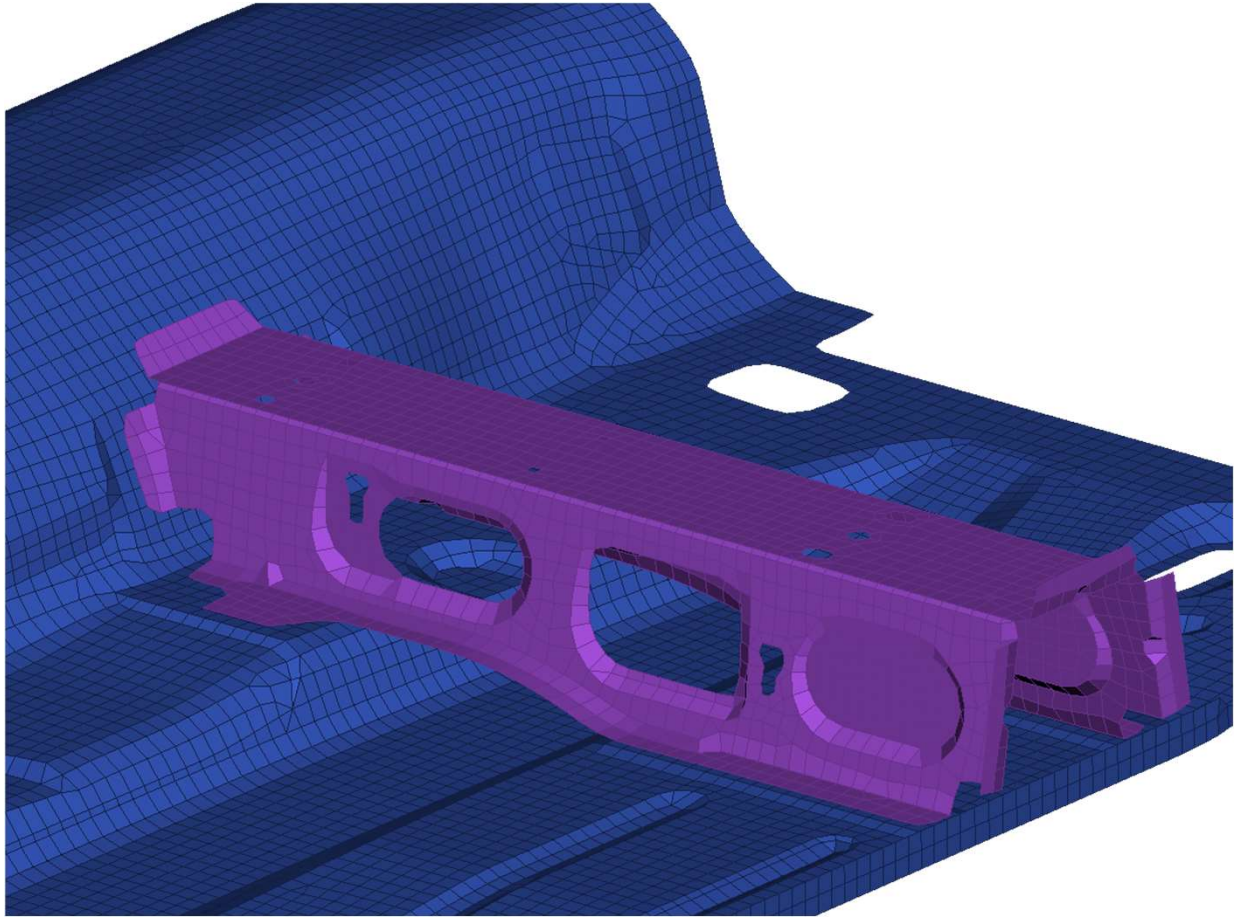




Direct Morphing

Design Change: Position

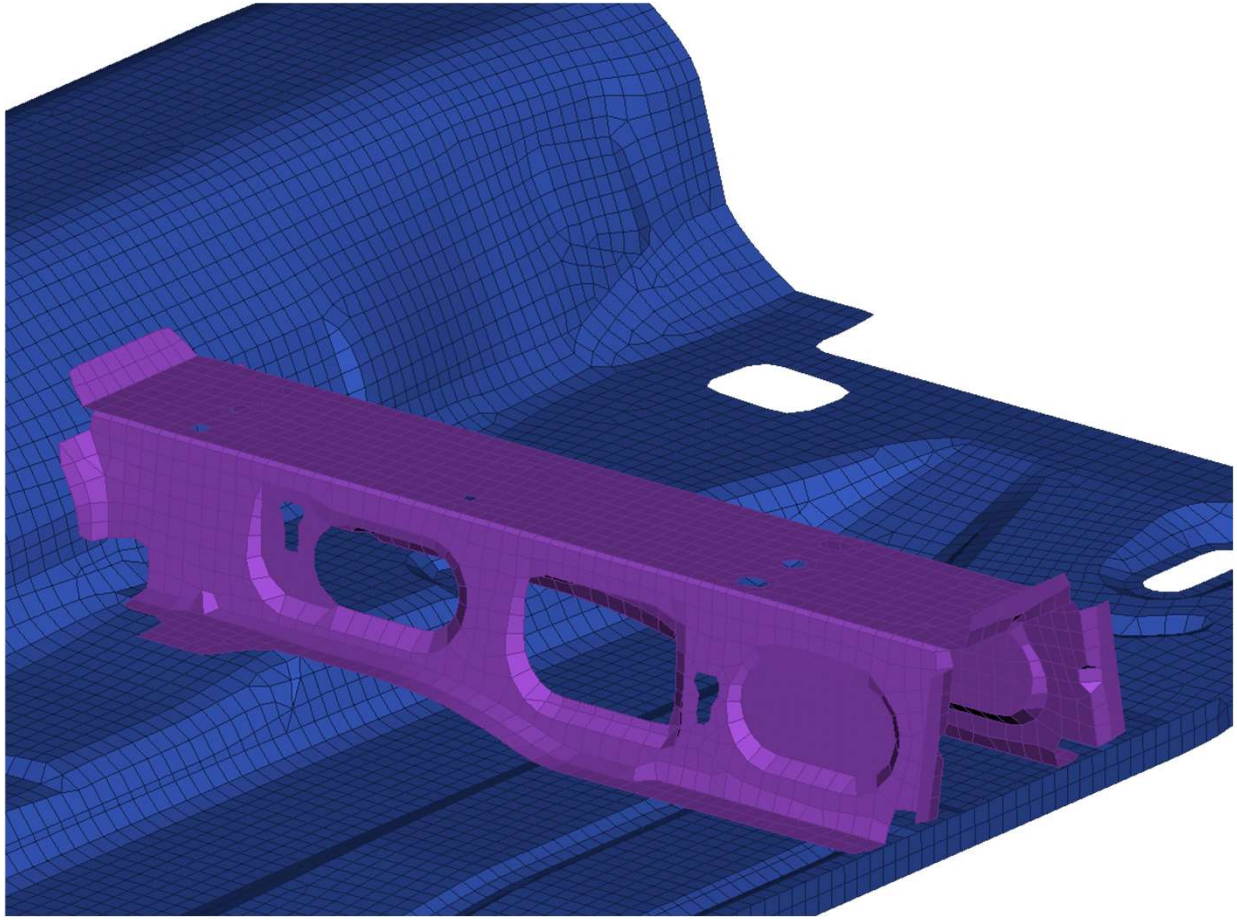
- Movement of members on their underlying surface
- Flanges and sidewalls are adapted on target position



Direct Morphing

Design Change: Position

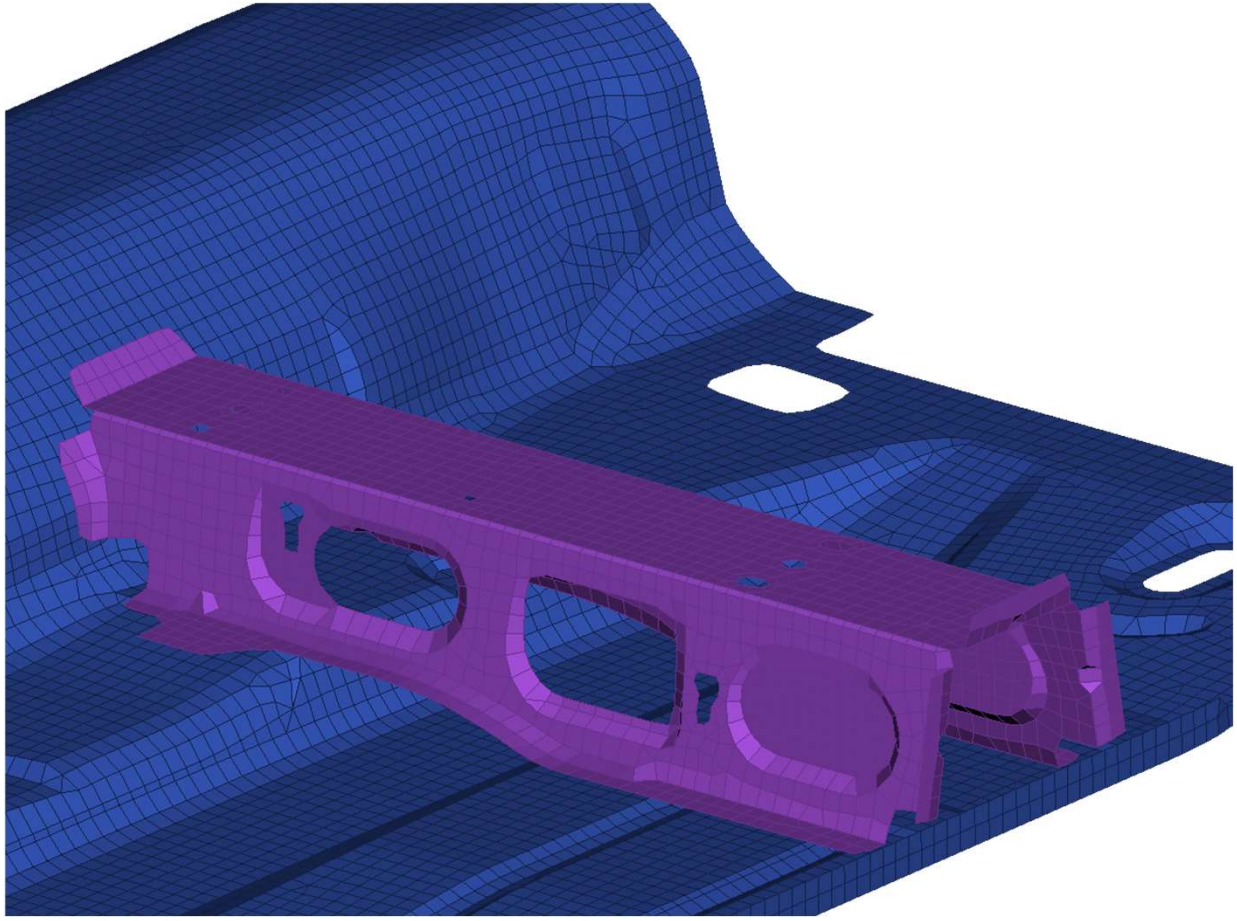
- Movement of members on their underlying surface
- Flanges and sidewalls are adapted on target position



Direct Morphing

Design Change: Position

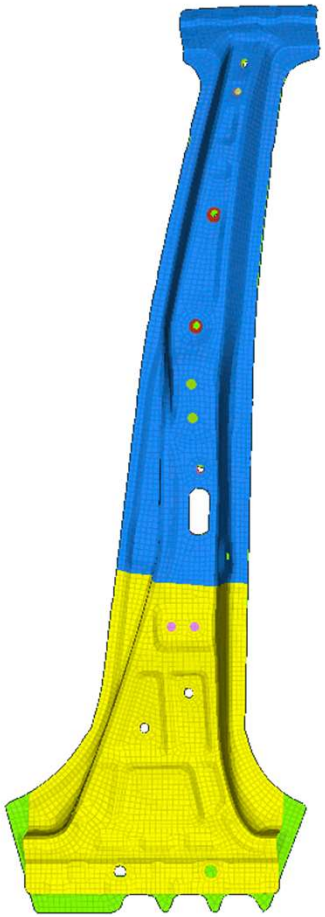
- Movement of members on their underlying surface
- Flanges and sidewalls are adapted on target position

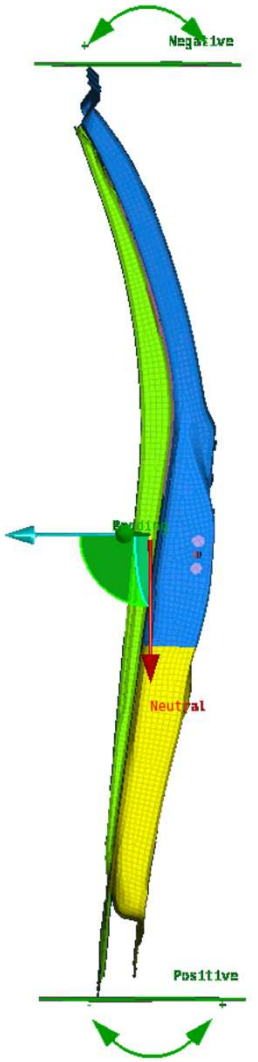


Direct Morphing

Form (Bend)

Form parts by maintaining their cross-section





Direct Morphing

Spotweld Density

Adjust or preserve density of Spotweld Groups

Direct Morphing

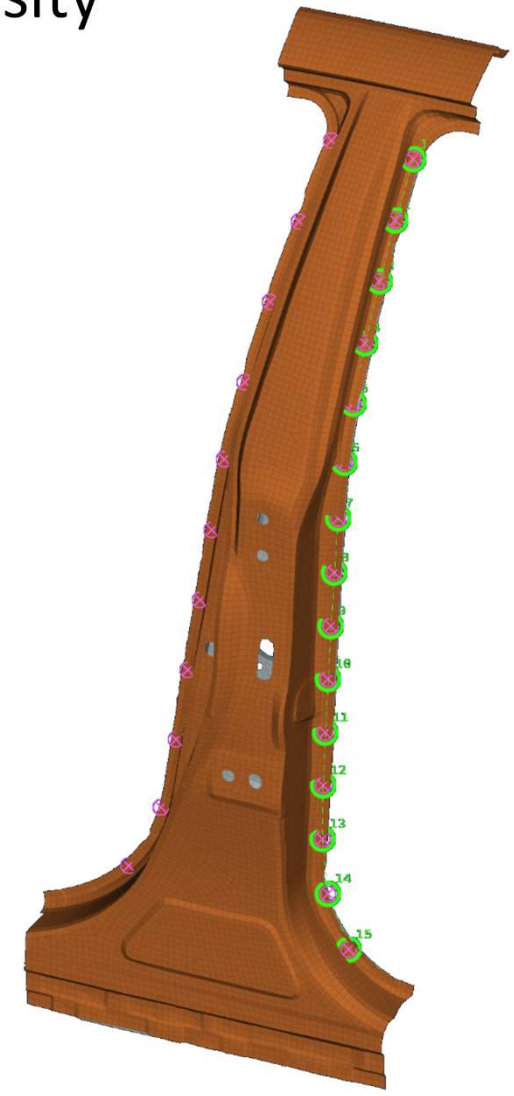
Spotweld Density

Adjust or preserve density of Spotweld Groups

Direct Morphing

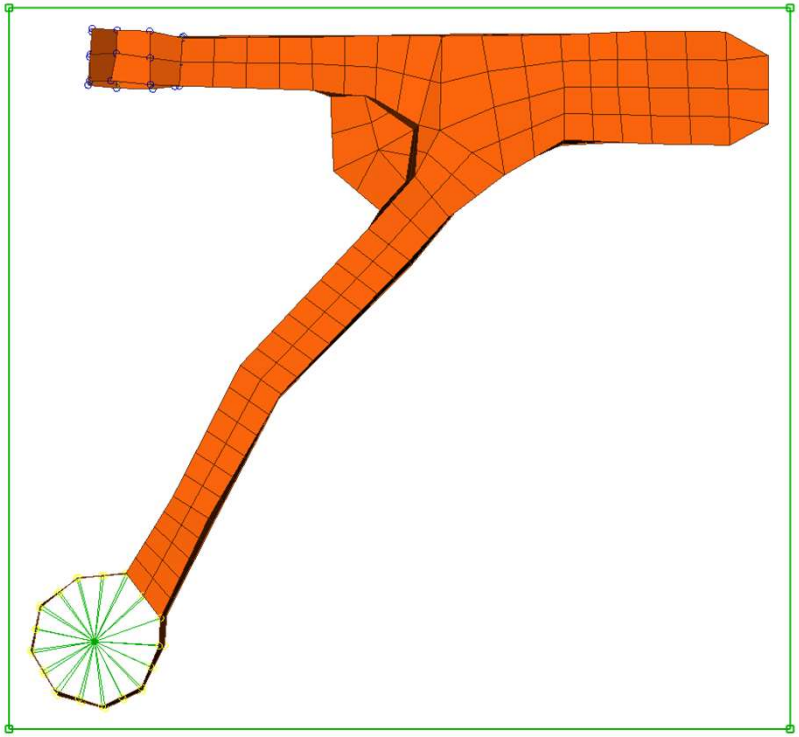
Spotweld Density

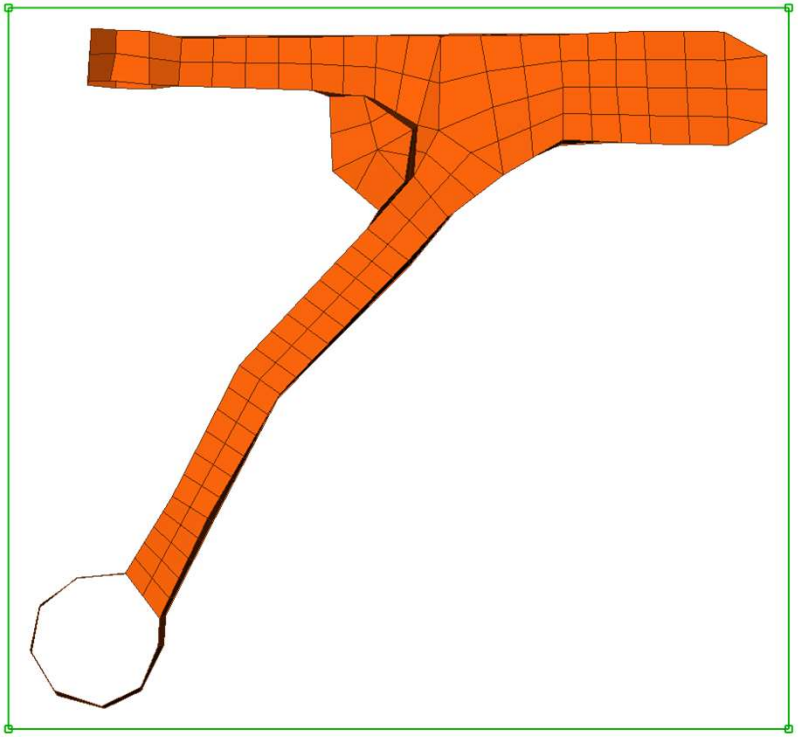
Adjust or preserve density of Spotweld Groups



Morphing Constraints

- Nested Elements for Box and Direct Morphing
- DFM Constraints (e.g. Planar, Rigid, Flange, Path Follower, …)
- Freeze, rigidize, constrain feature-movement during morphing





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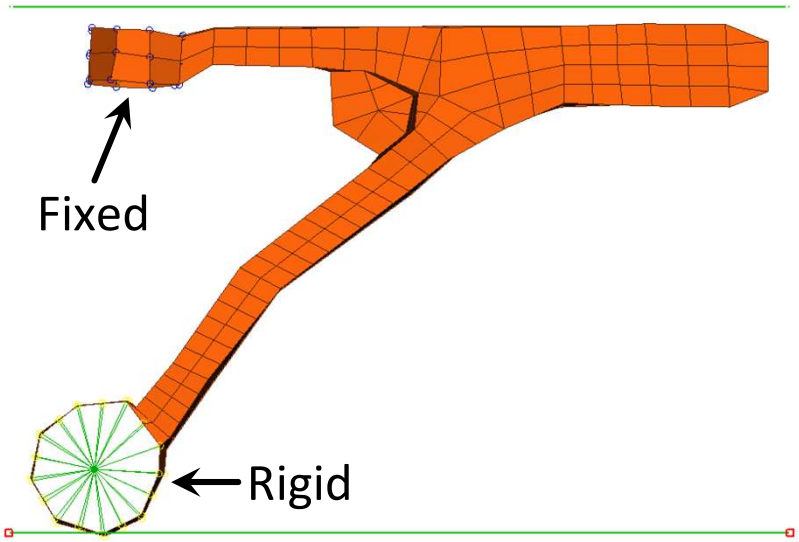
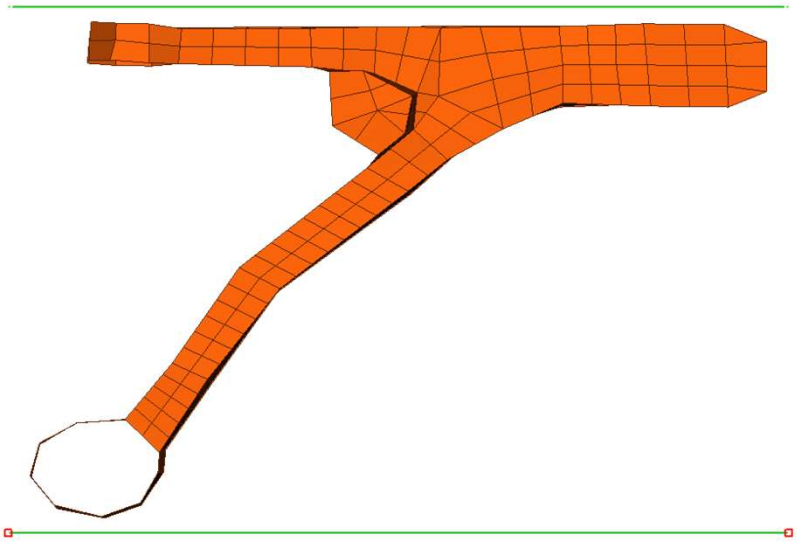


With Constraints



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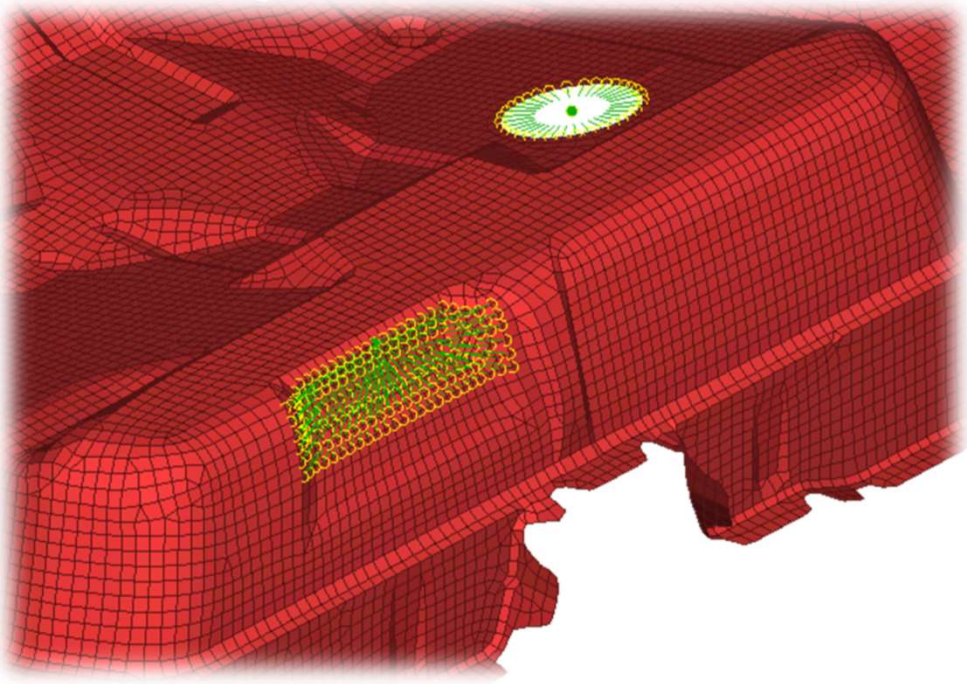

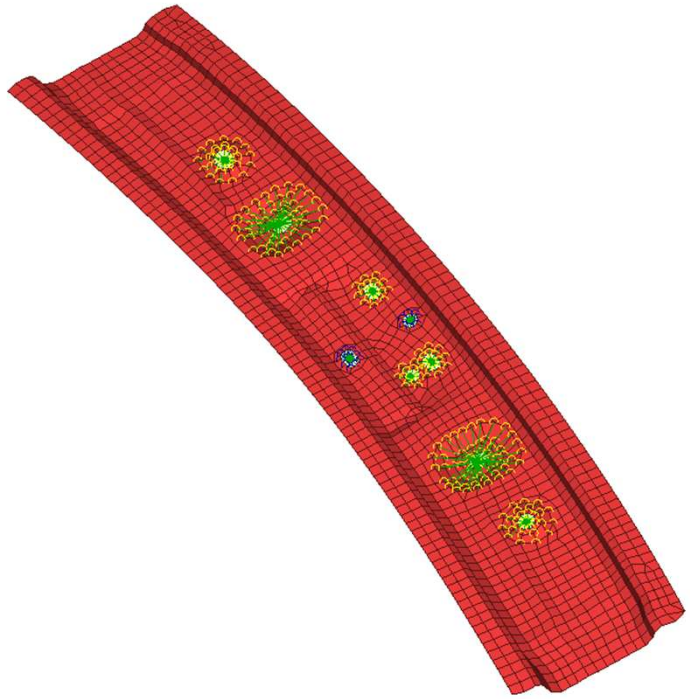

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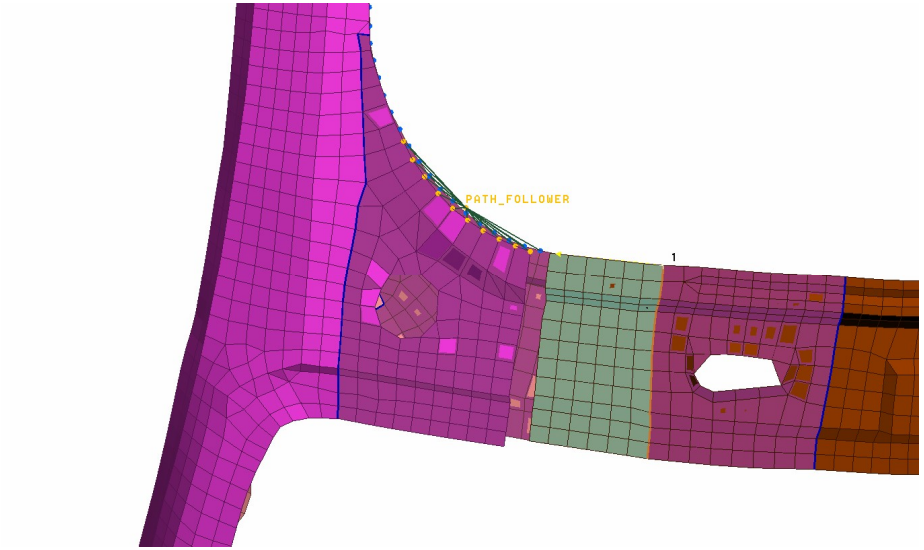
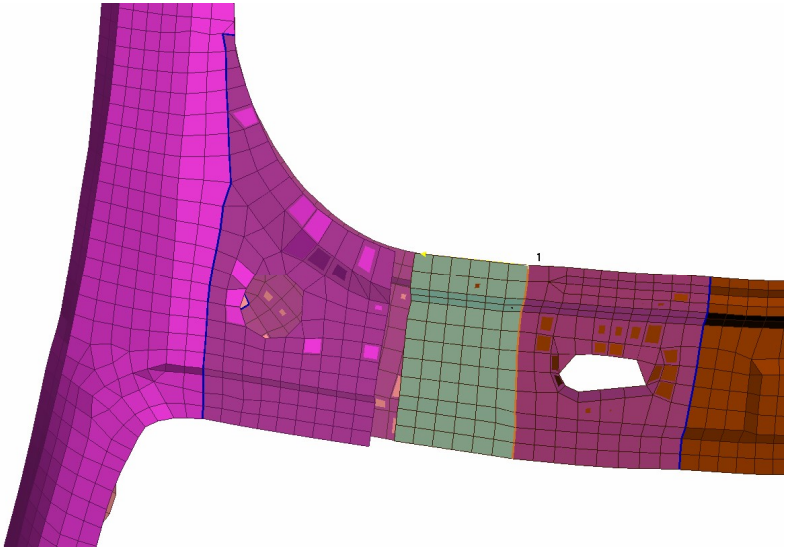


With Path Follower Constraint



Without Constraint

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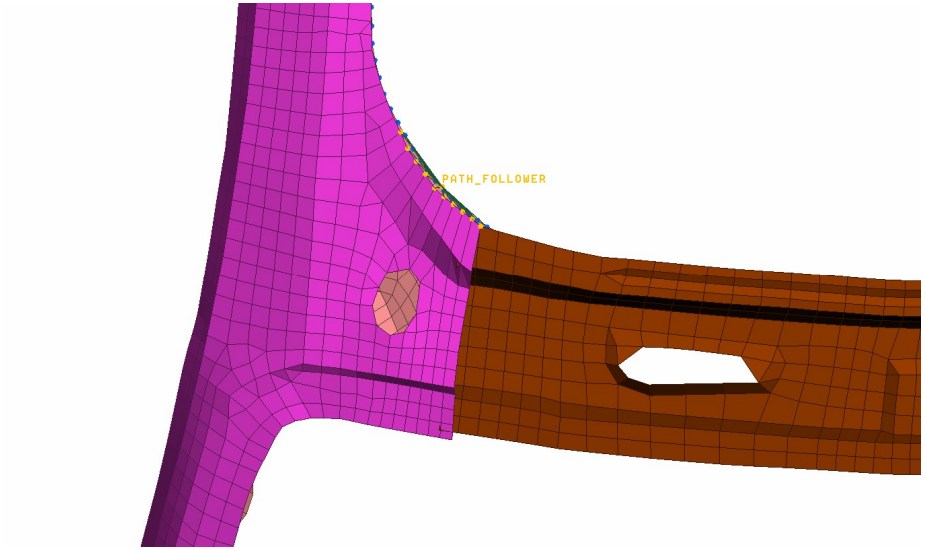
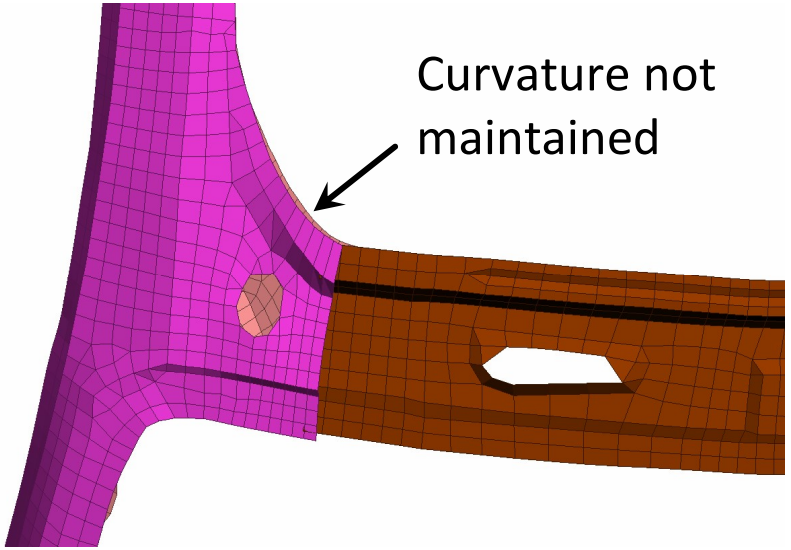


With Path Follower Constraint



Without Constraint

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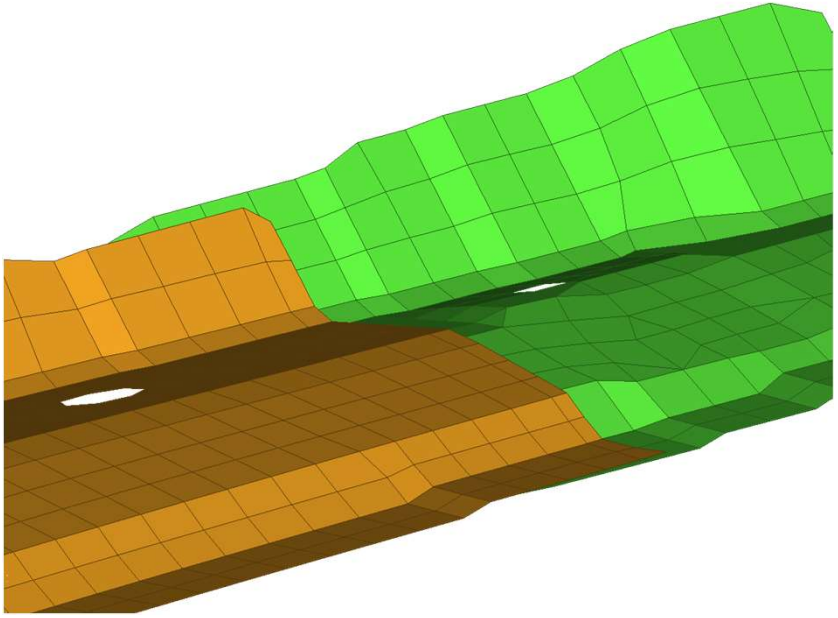
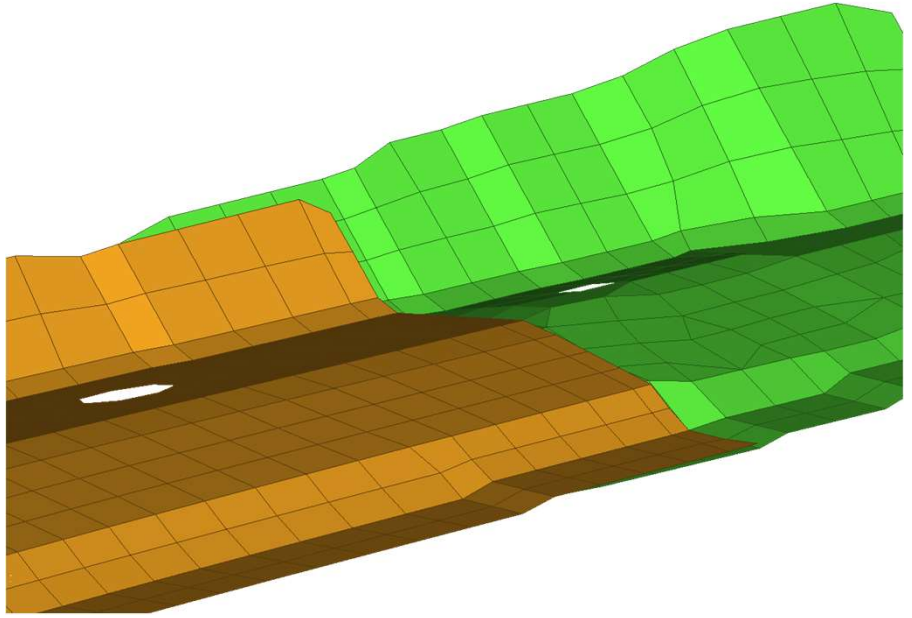


With Flange Constraint



Without Constraint

Morphing Constraints

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- DFM Constraints (e.g. Planar, Rigid, Flange, Path Follower, …)
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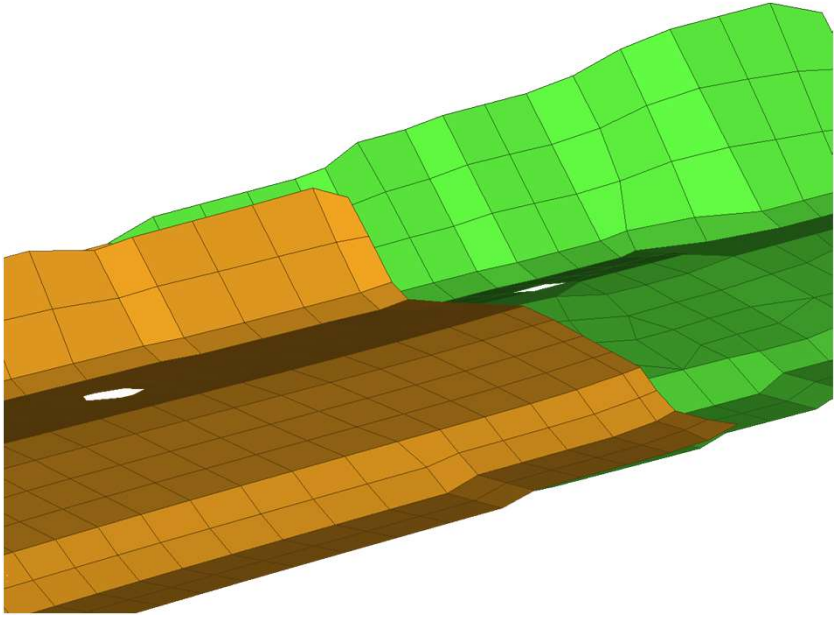
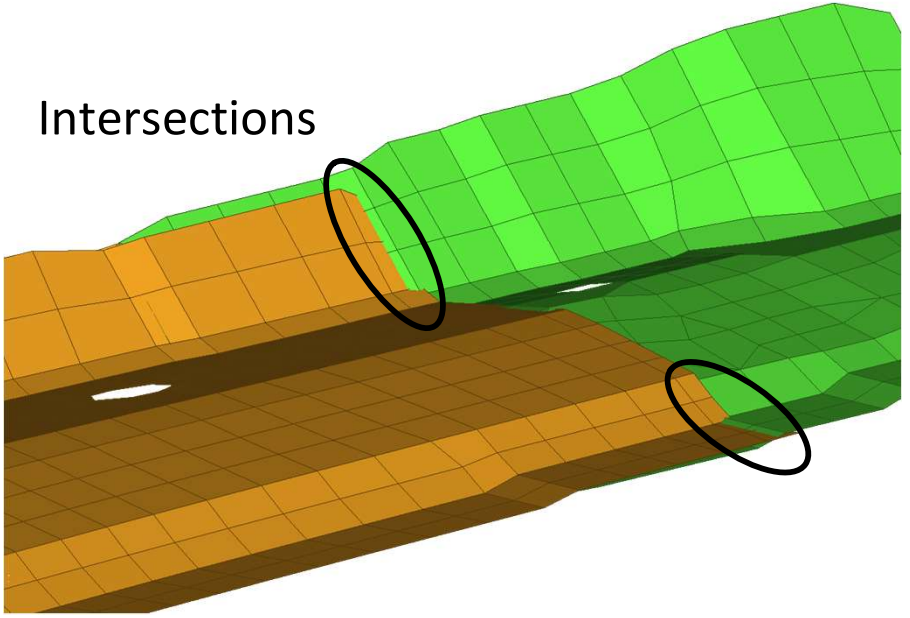


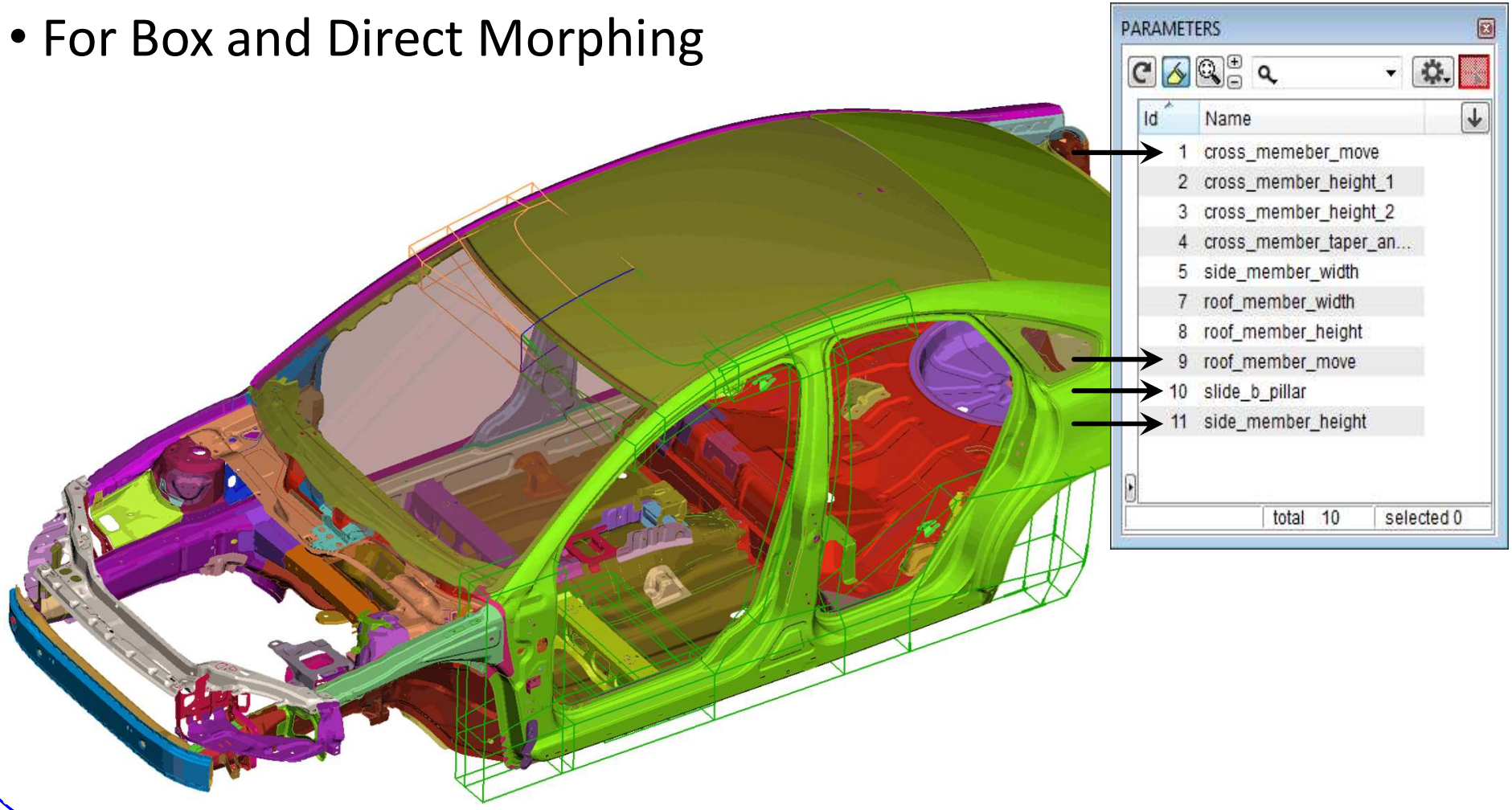
With Flange Constraint



Without Constraint

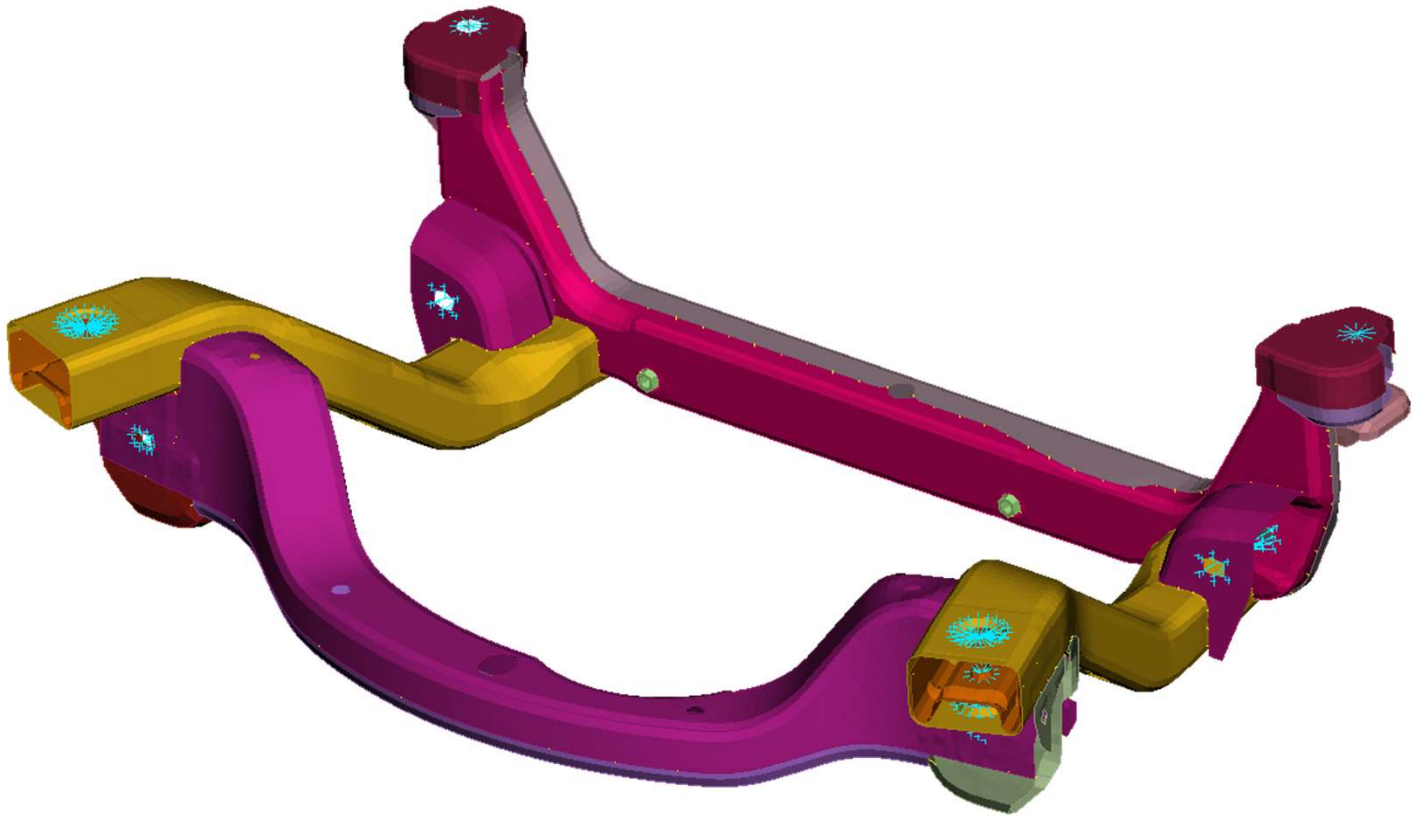
Morphing Parameters

- For Box and Direct Morphing



Morphing Parameters

Video Recording



Morphing Parameters

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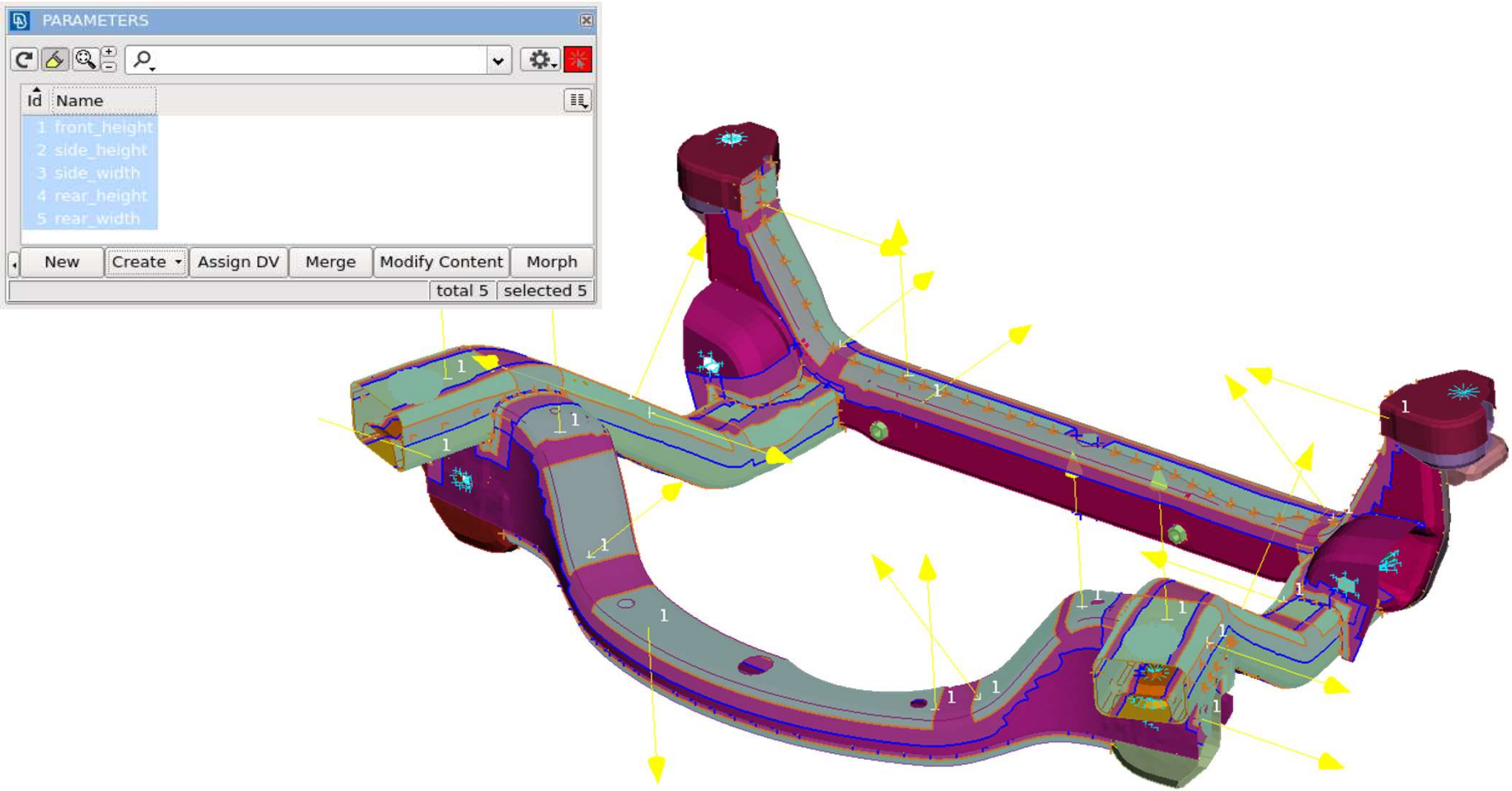

Morphing Parameters

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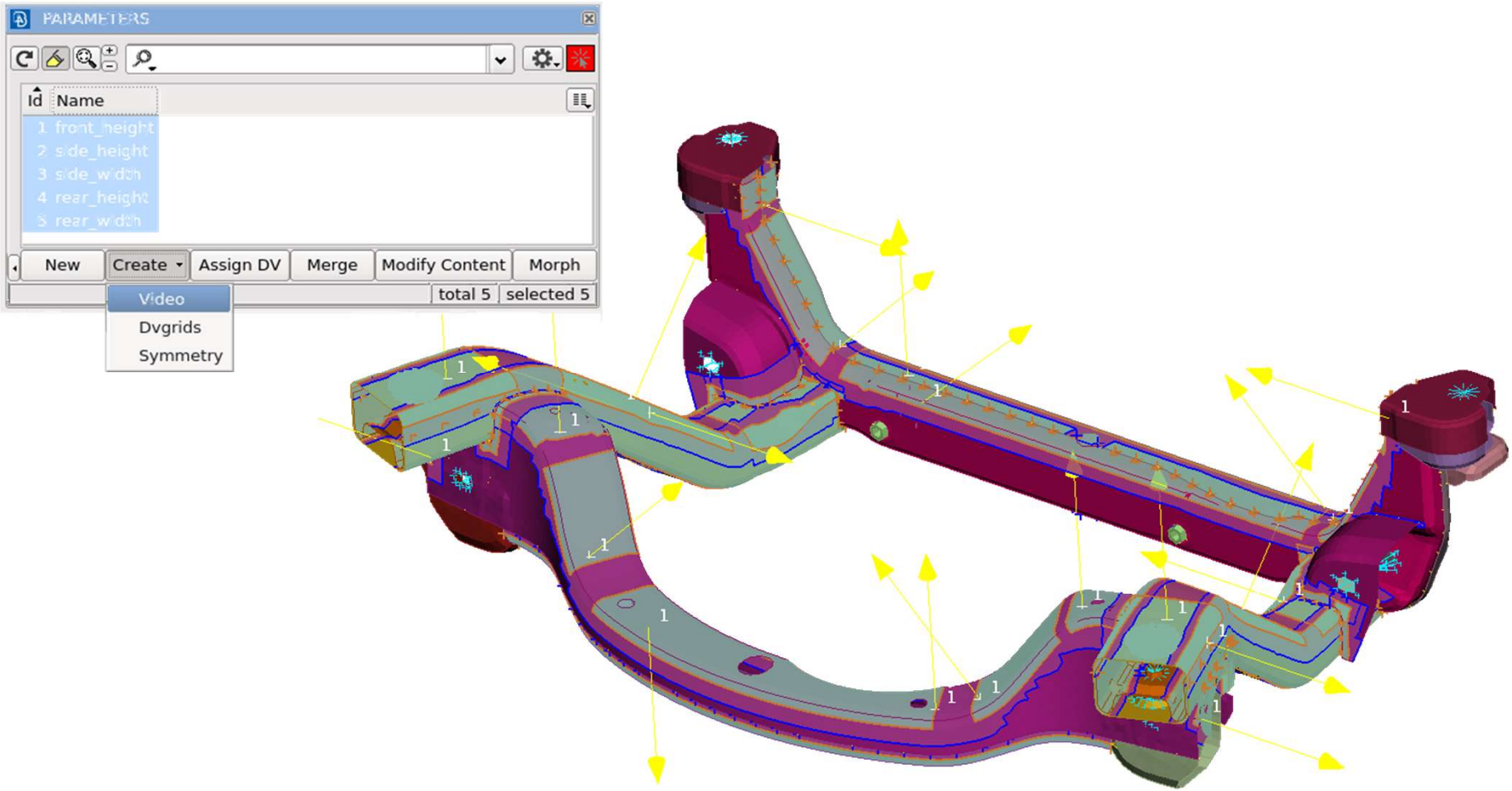

Morphing Parameters

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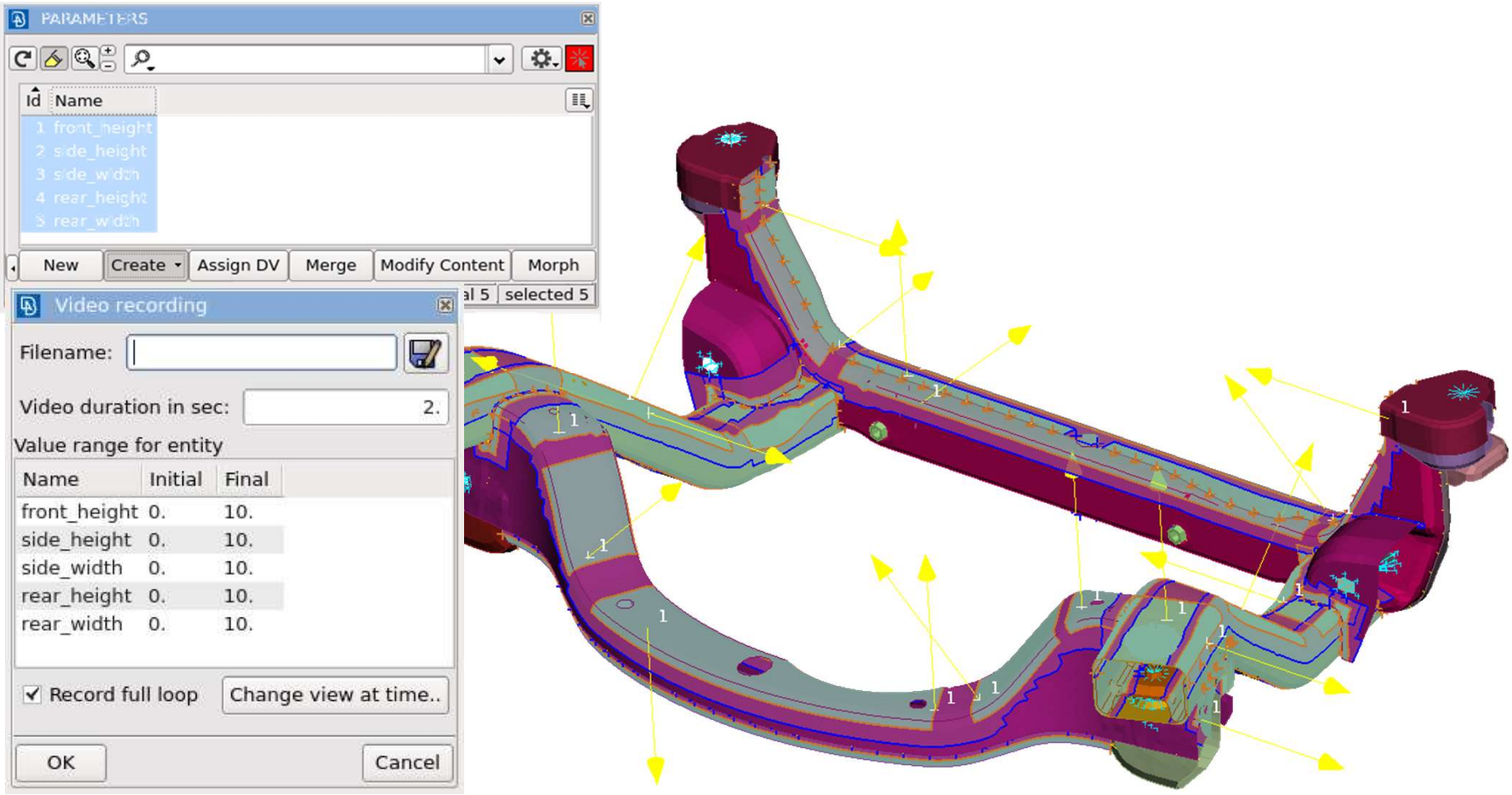

Morphing Parameters

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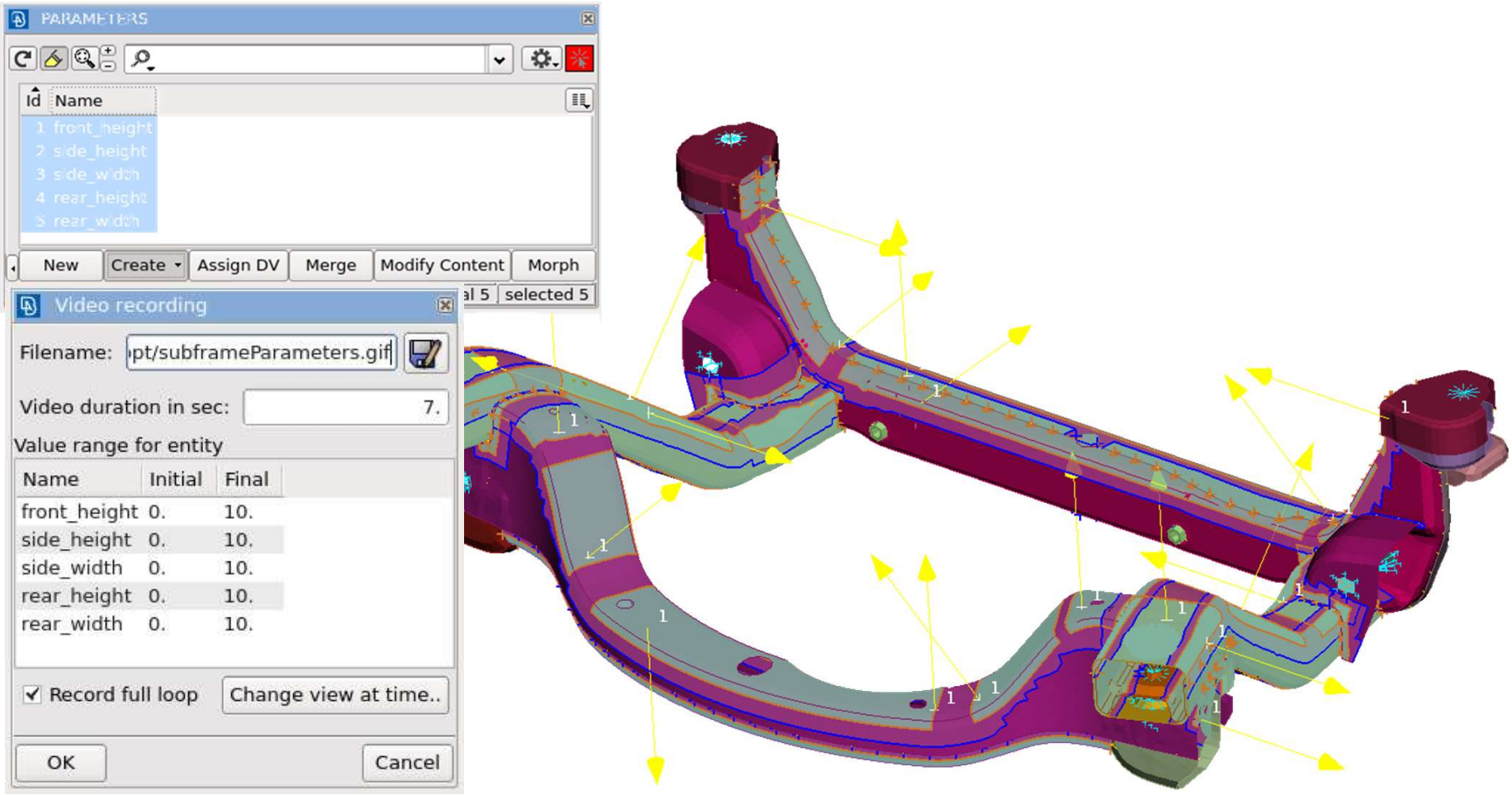
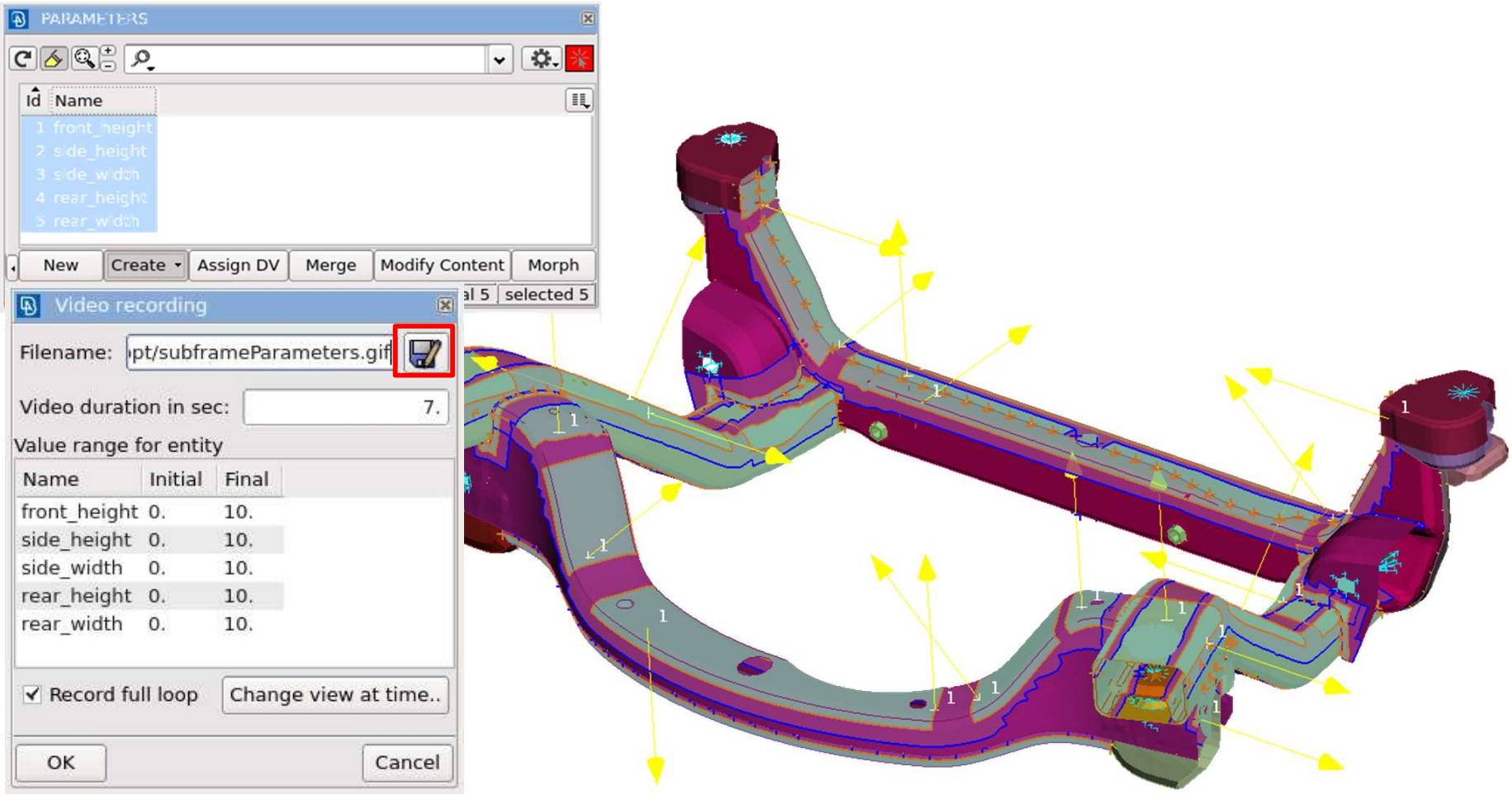


Morphing Parameters

Video Recording



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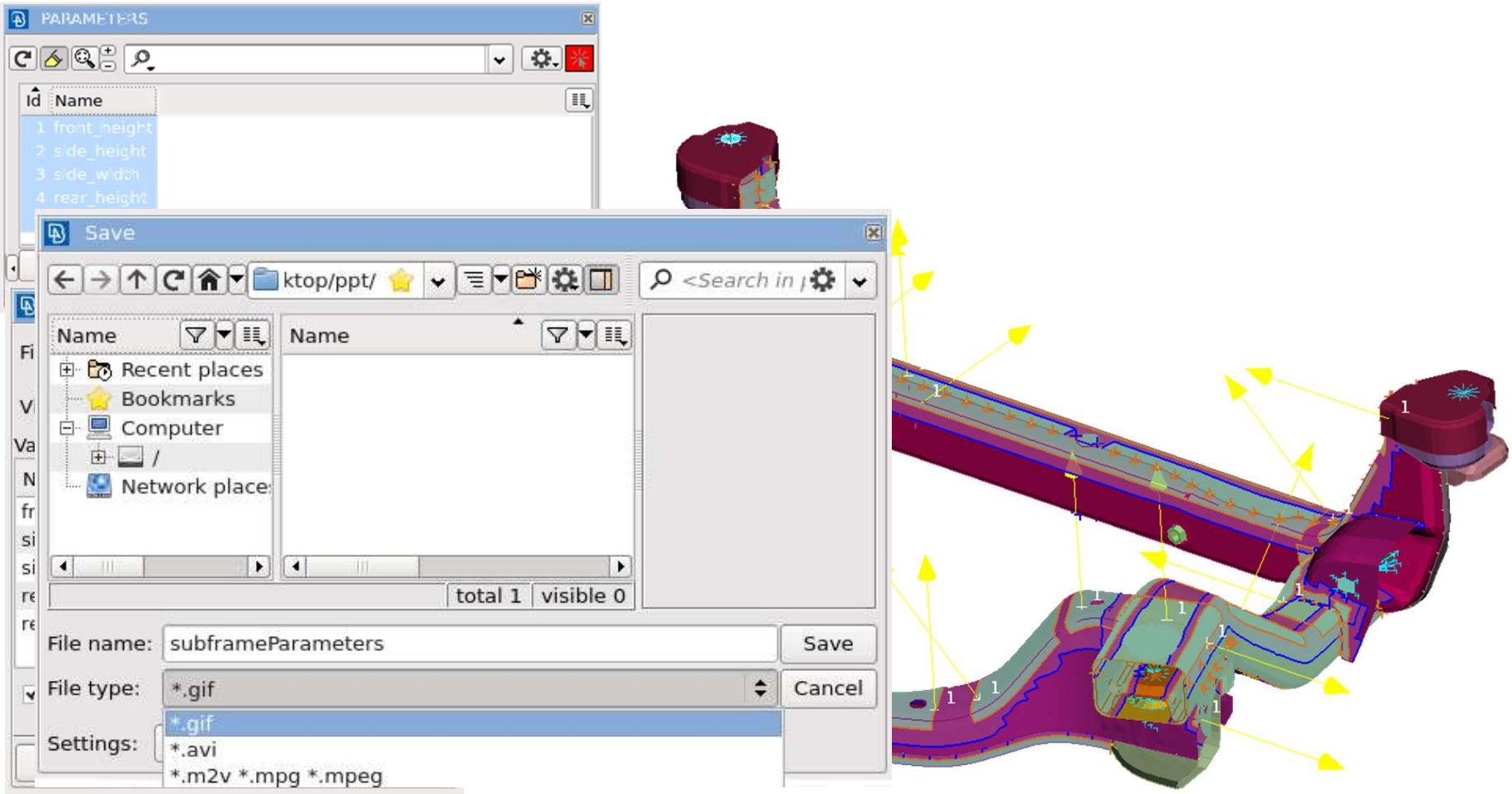

Morphing Parameters

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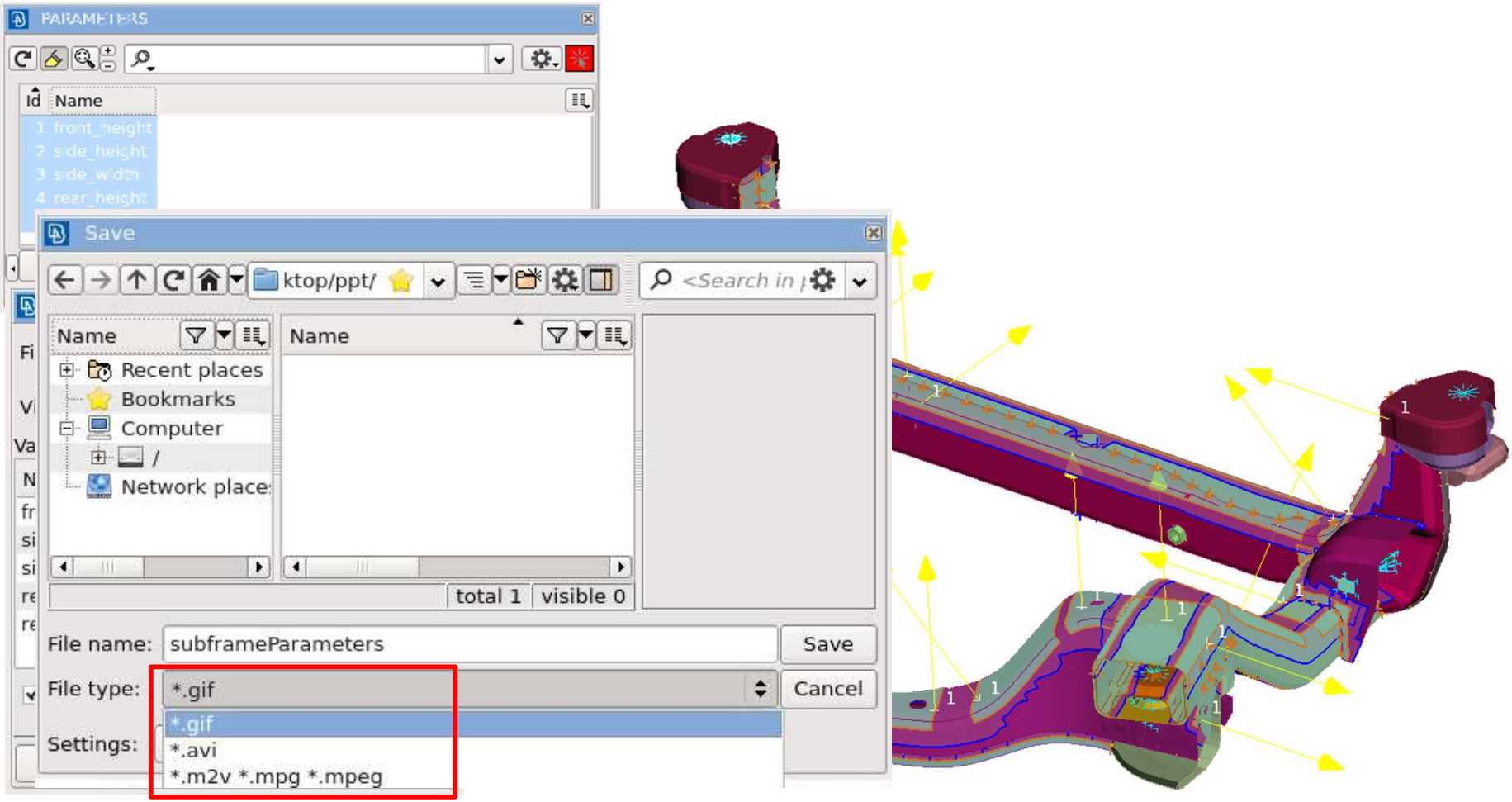

Morphing Parameters

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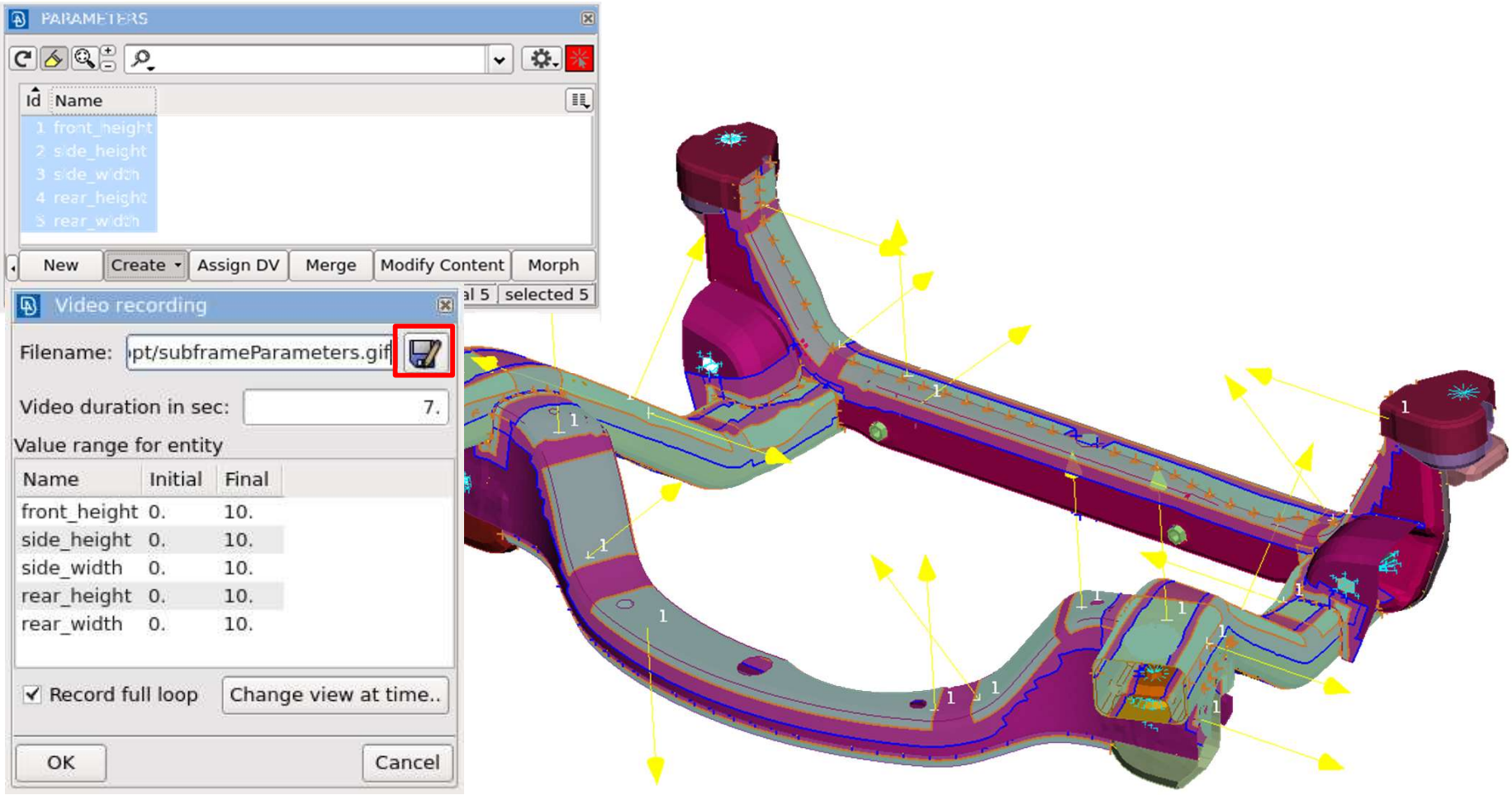

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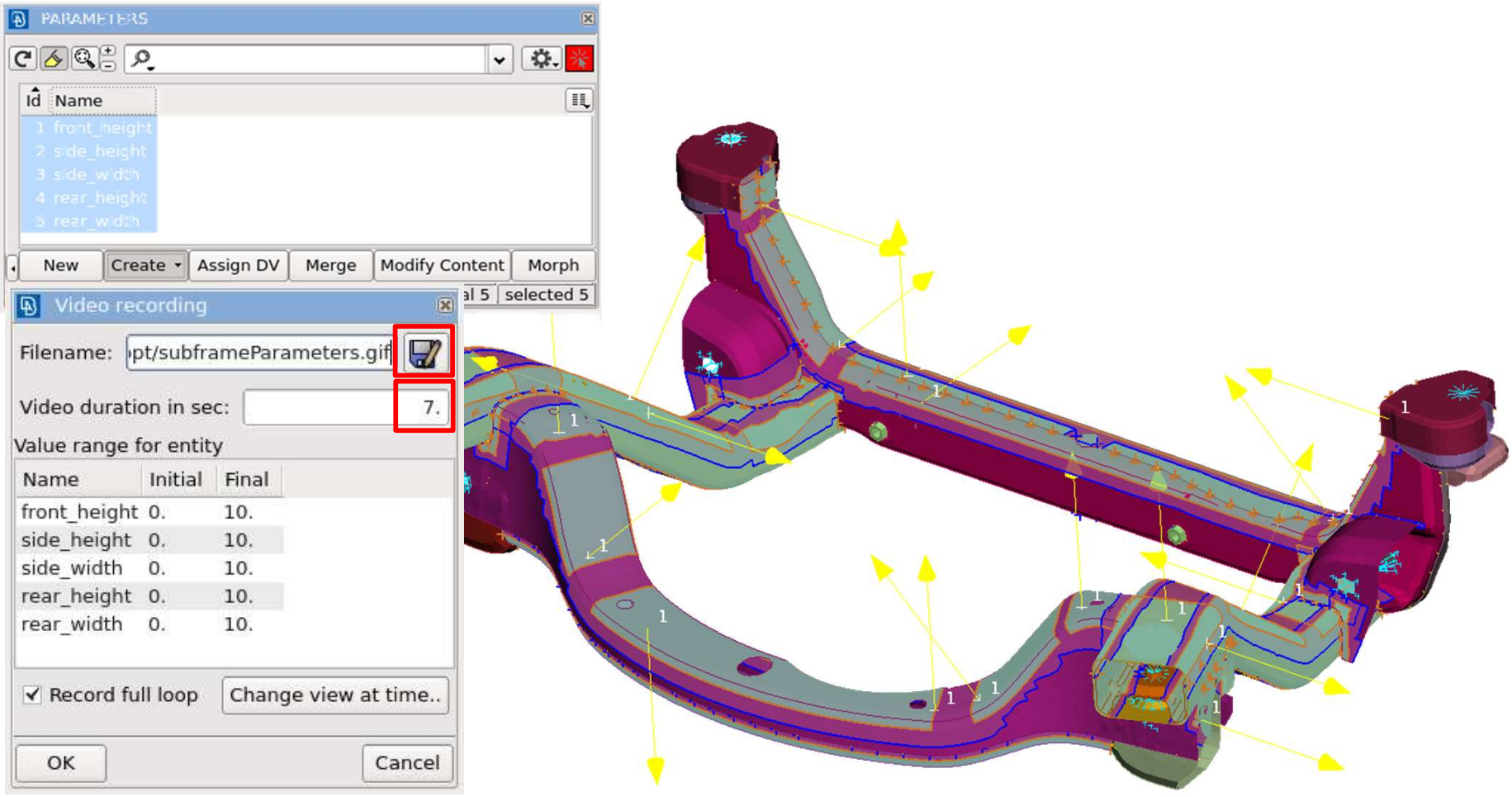

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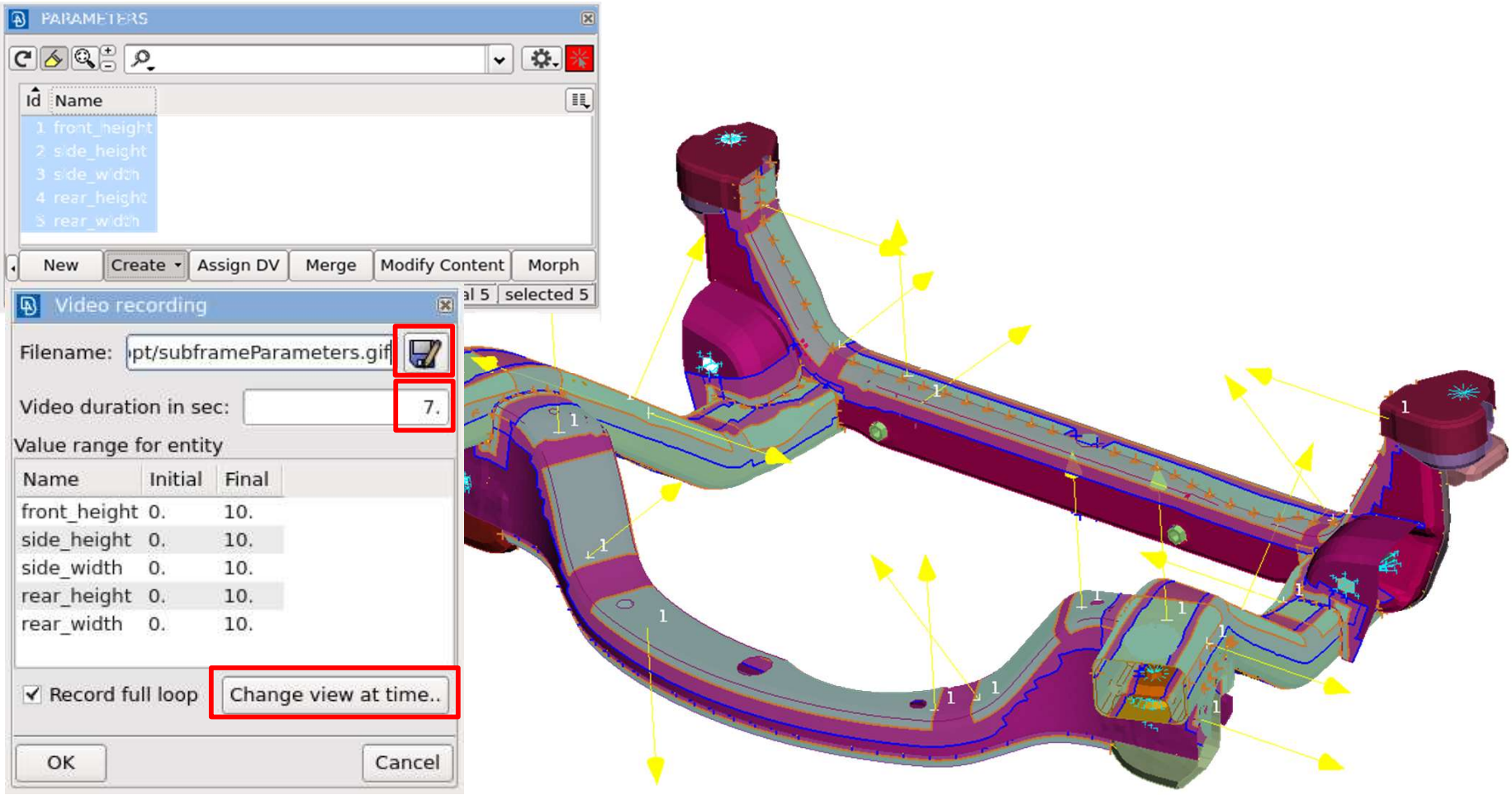

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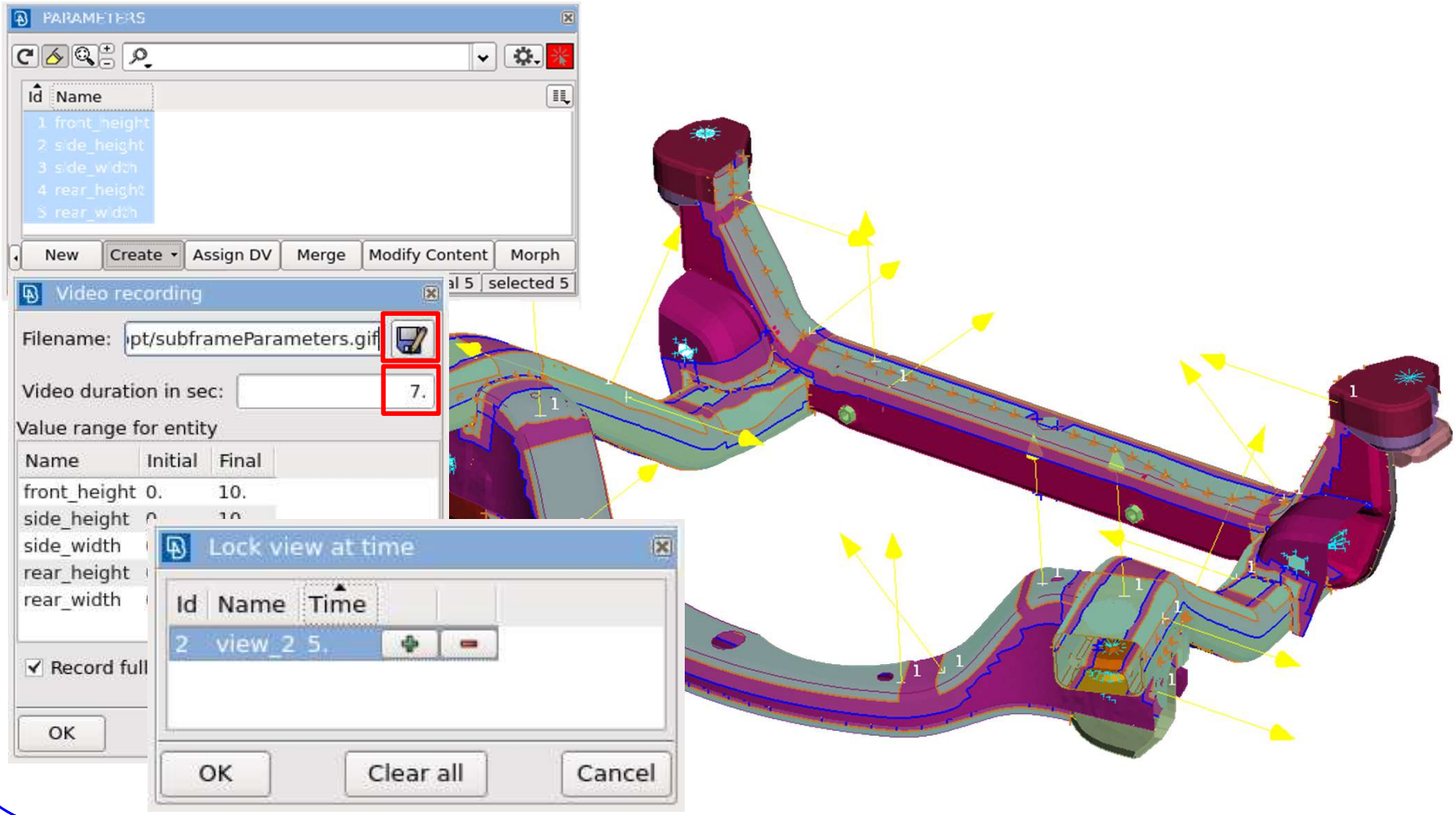


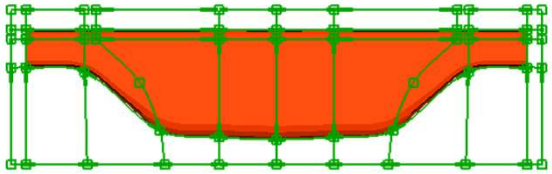
Morphing Parameters

Video Recording

Record Morphing Actions

Deformation Parameter

- Records any Box or Direct Morphing action
- Get any interpolation / extrapolation between undeformed and deformed shape with a single parameter



Initial shape – start recording

Record Morphing Actions

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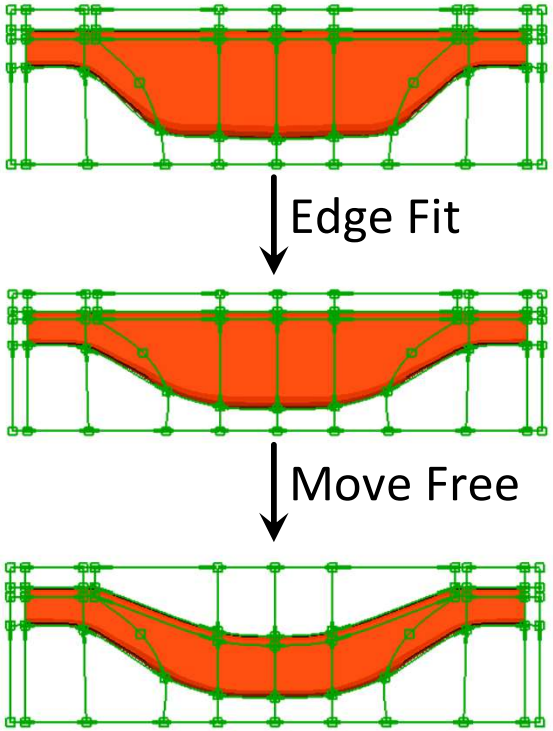

Initial shape – start recording

Deformed shape – stop recording

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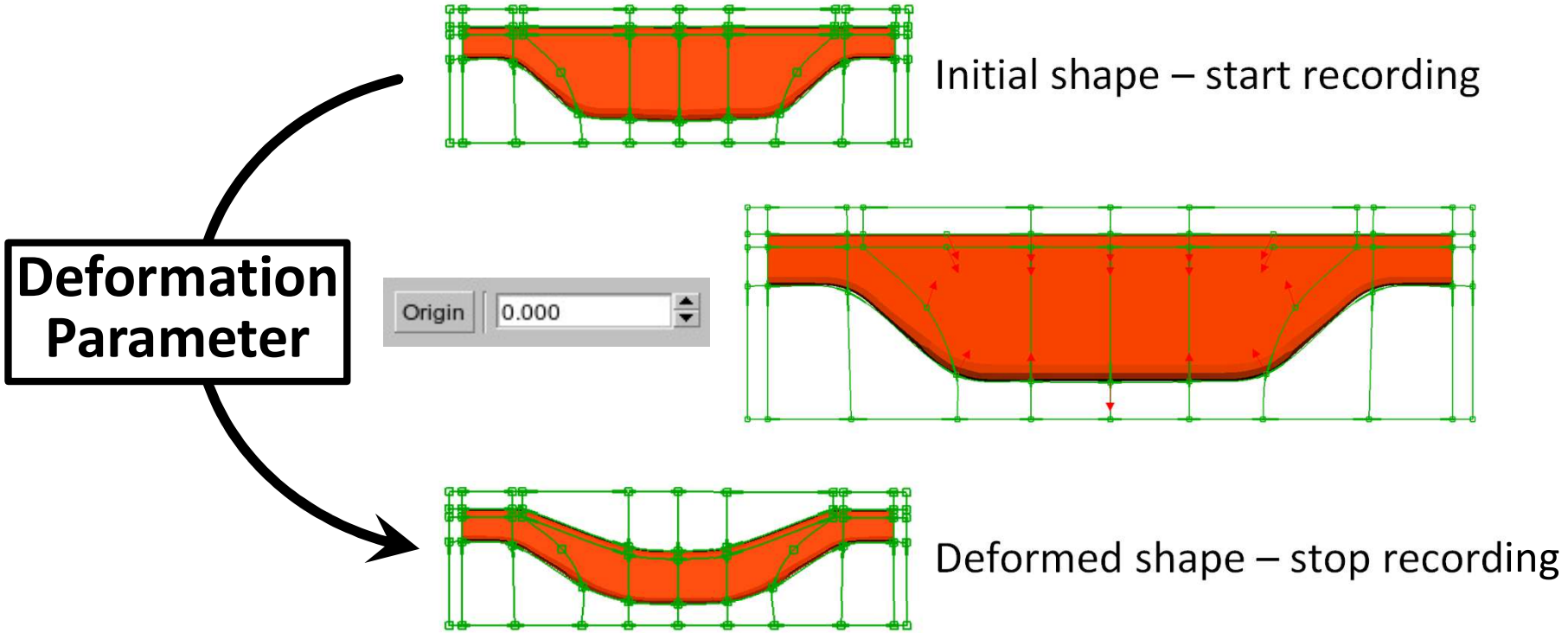

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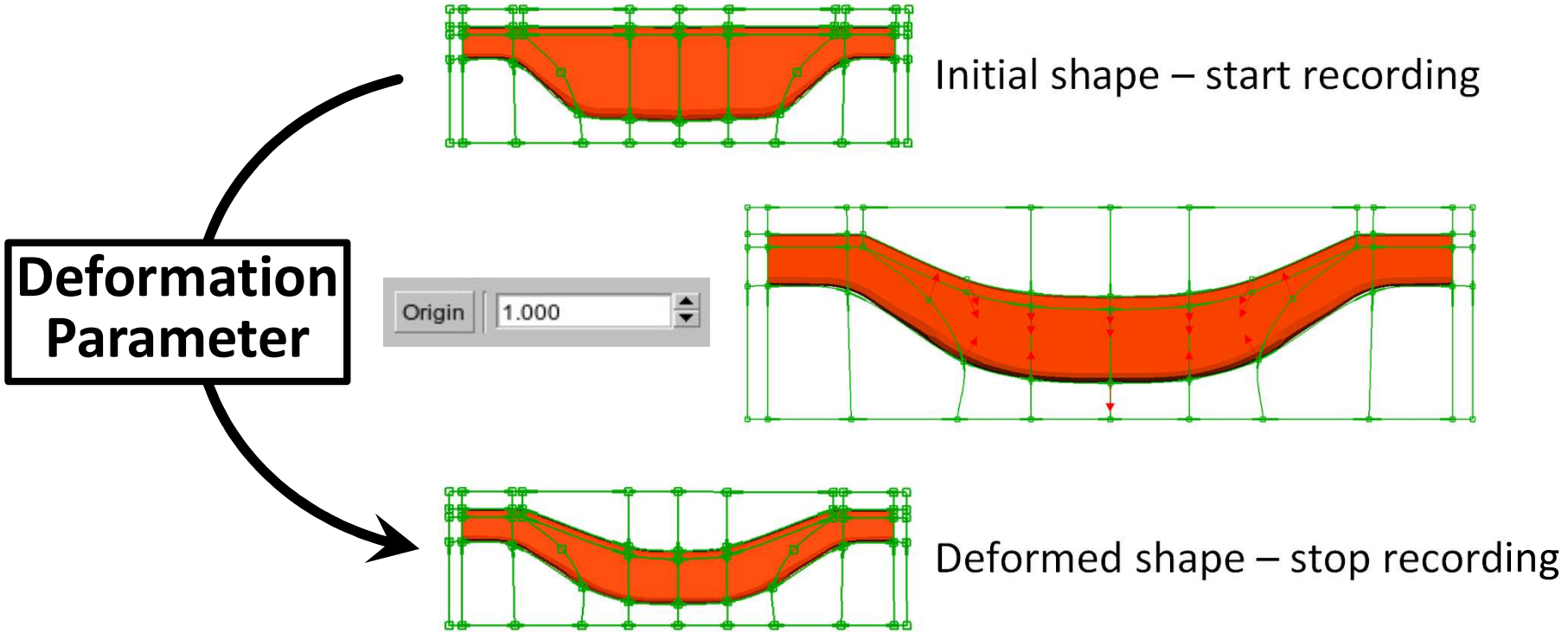
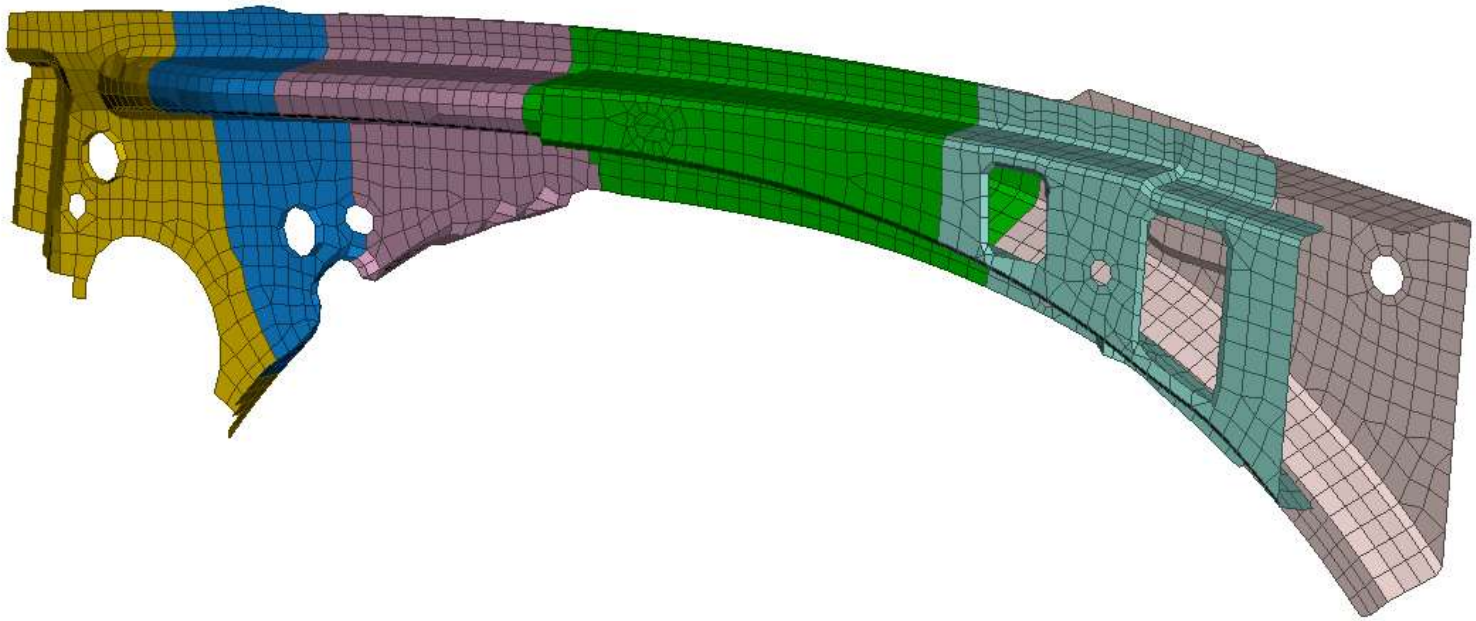


Taylor Welded Blanks Parameter

Parameterization and Optimization of Taylor Blanks



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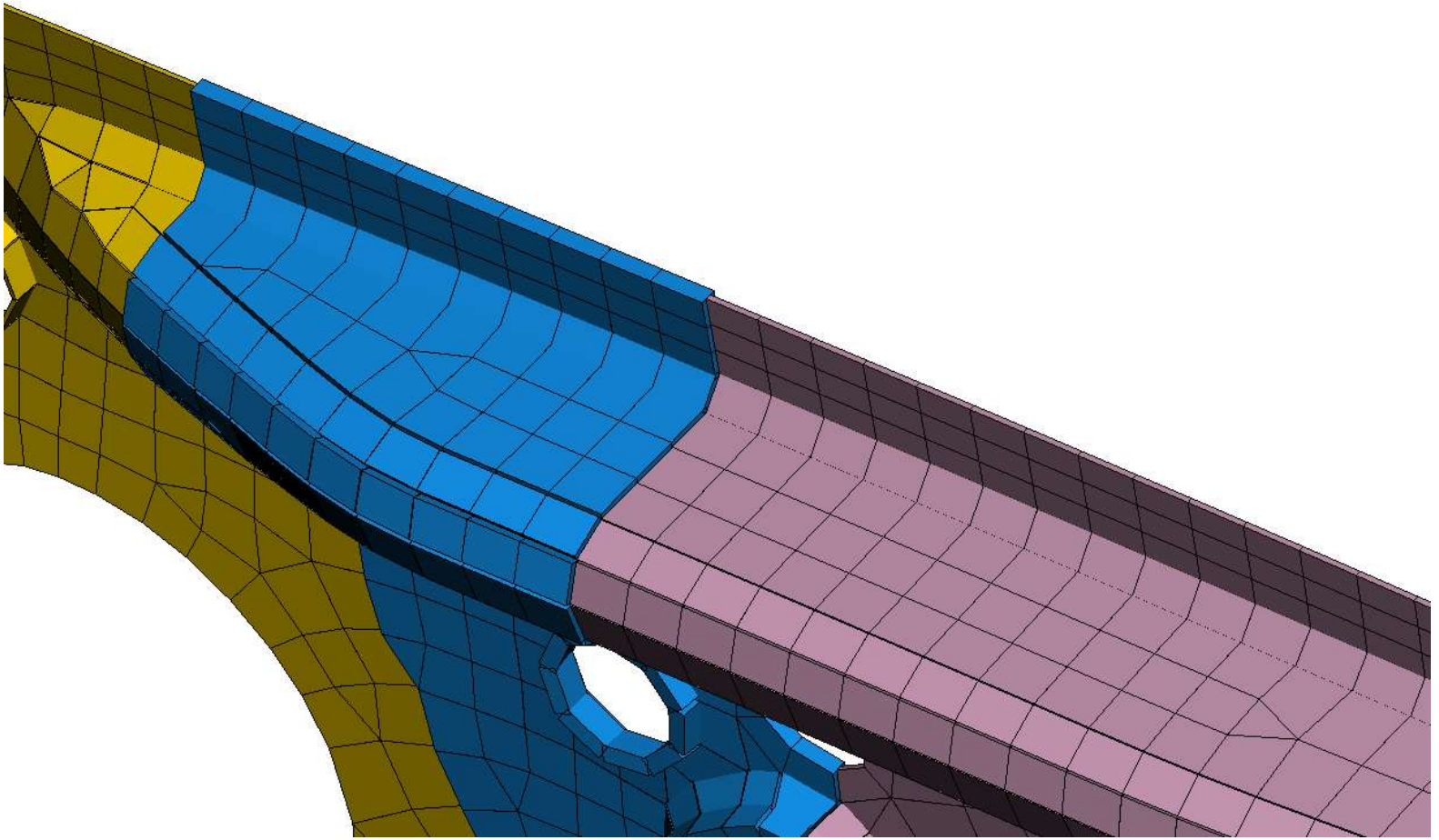
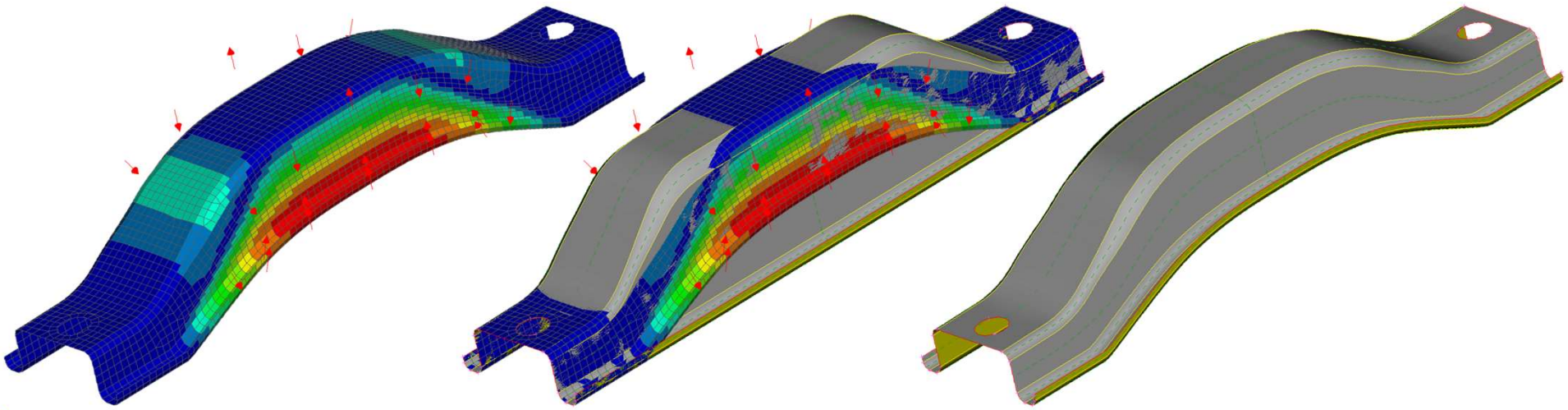


Mapping of Deformations

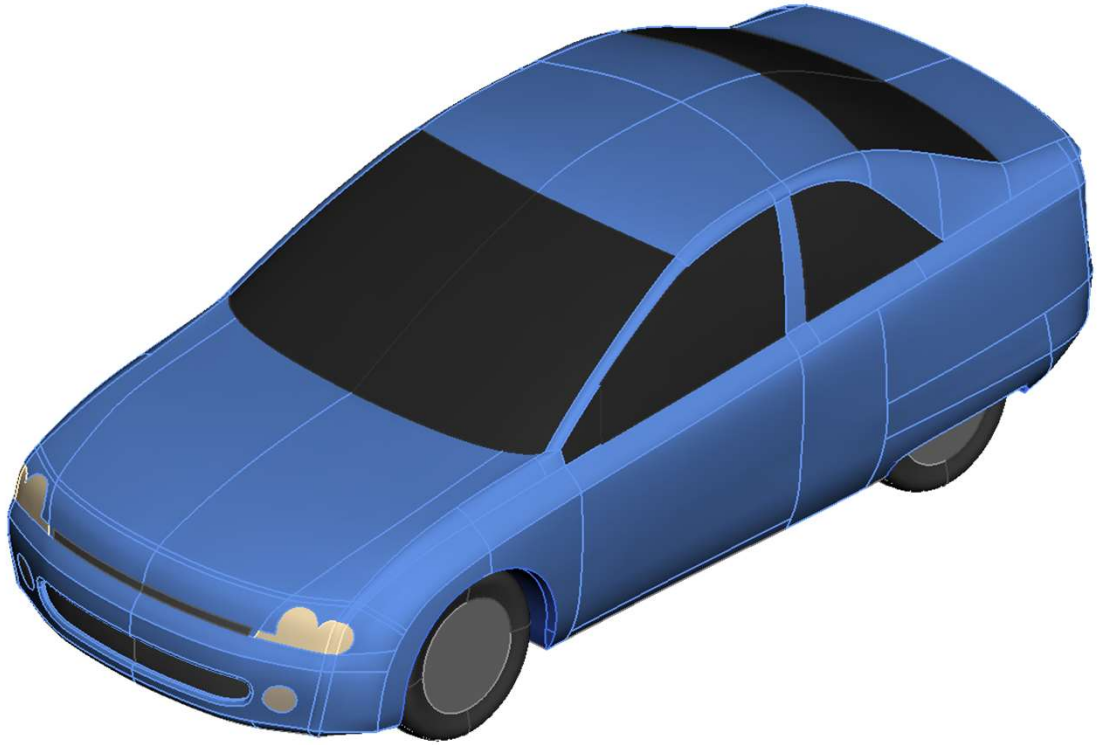
- Morph according existing deformation field from:
  - Deformation Parameter
  - History States
  - DESVAR of Nastran SOL 200
  - Text file
- E.g. Modify geometry according optimized FE-model



Functionalities assisting Morphing

3D Points and Curves

- Act as initial or target positions for fittings
- Suitable for Box and Direct Morphing
- Obtained from FE mesh or CAD geometry



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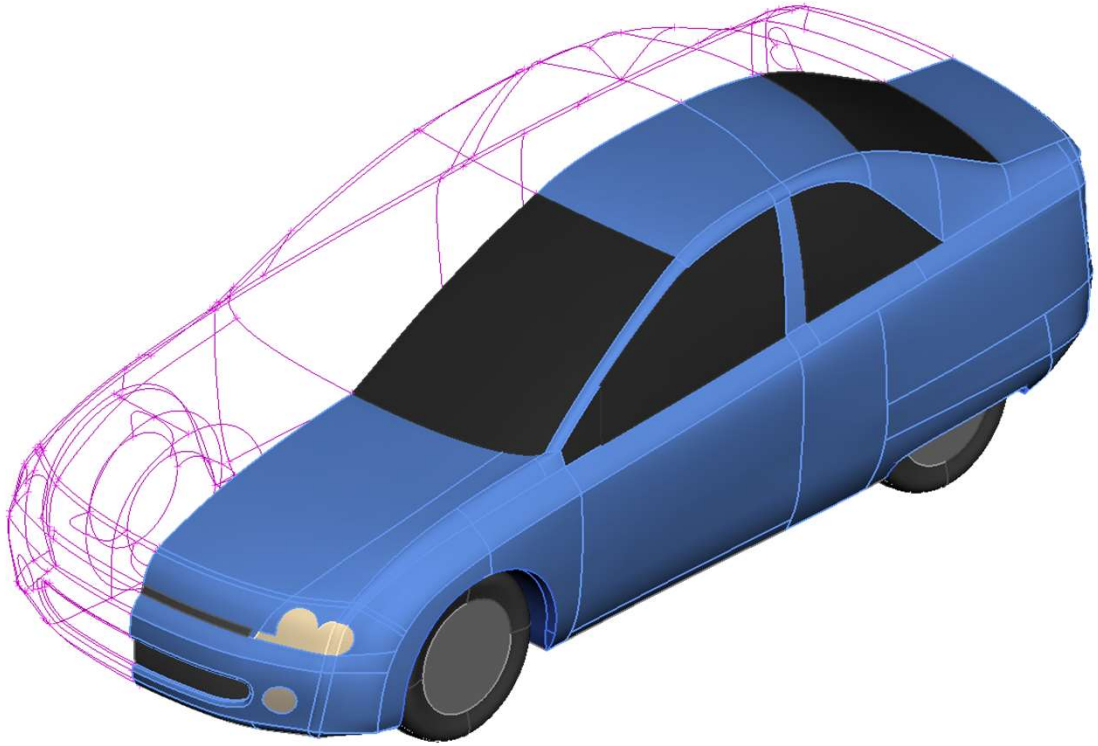
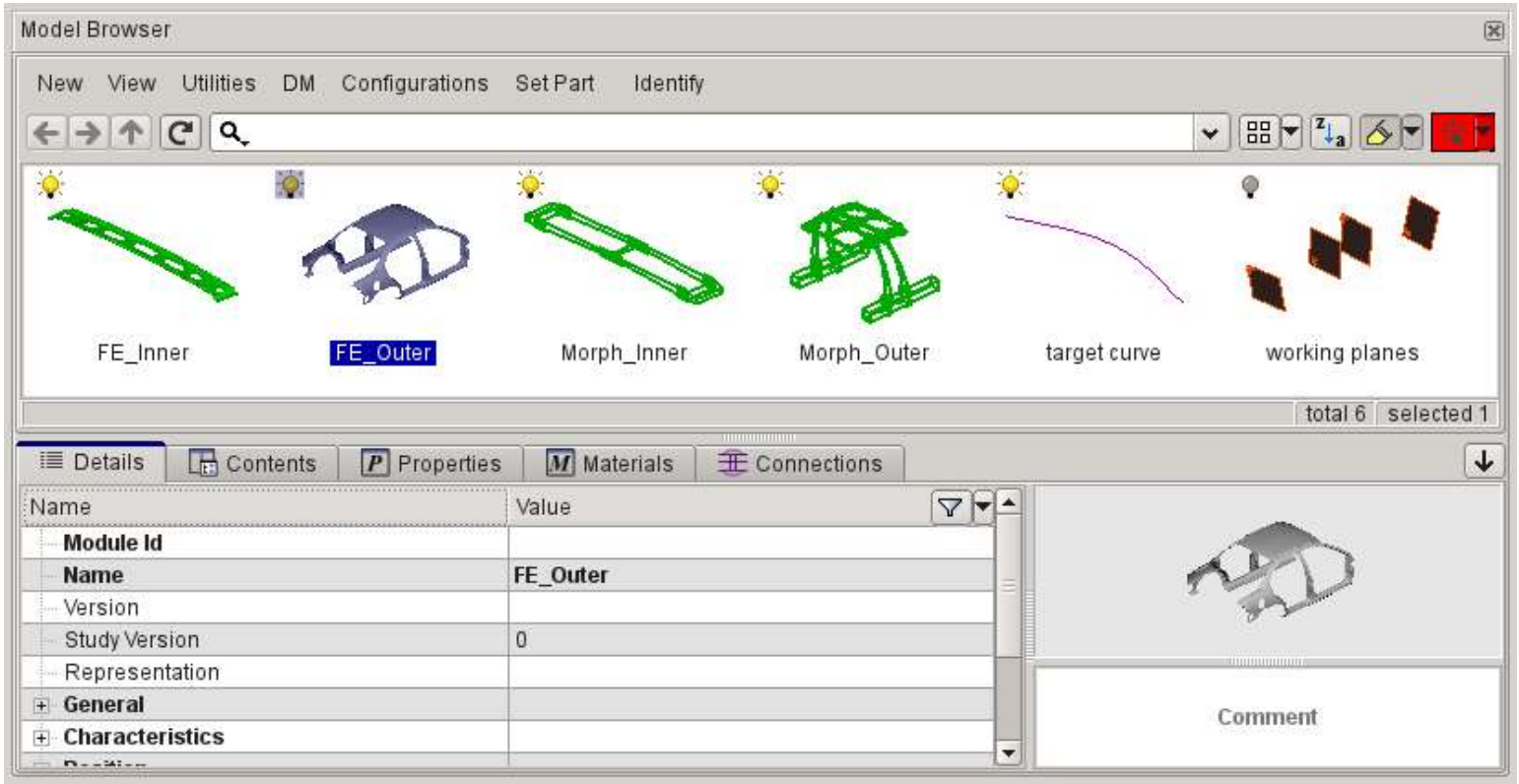


Functionalities assisting Morphing

Model Browser

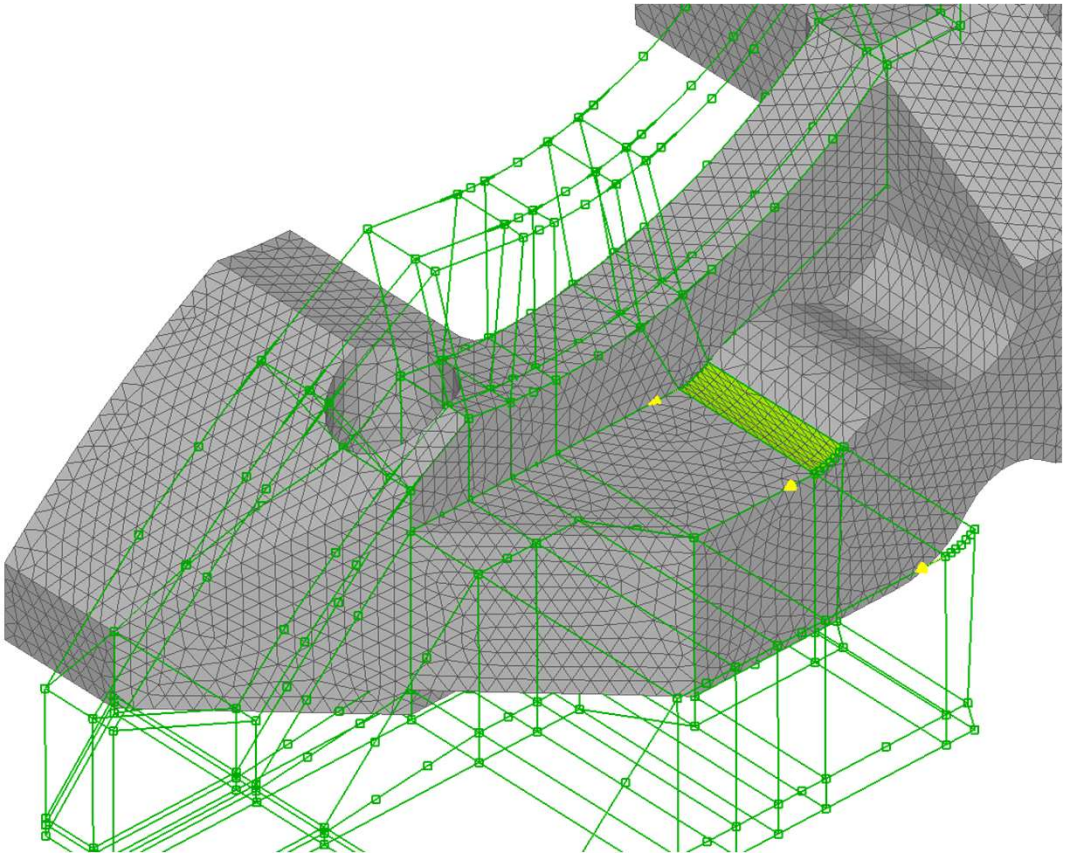
- Useful for Box Morphing (esp. complex configurations)
- To organize morph contents



Functionalities assisting Morphing

Reconstruct / Smooth morphed mesh

- Suitable for Box and Direct Morphing
- Improve mesh after morphing with large deformations



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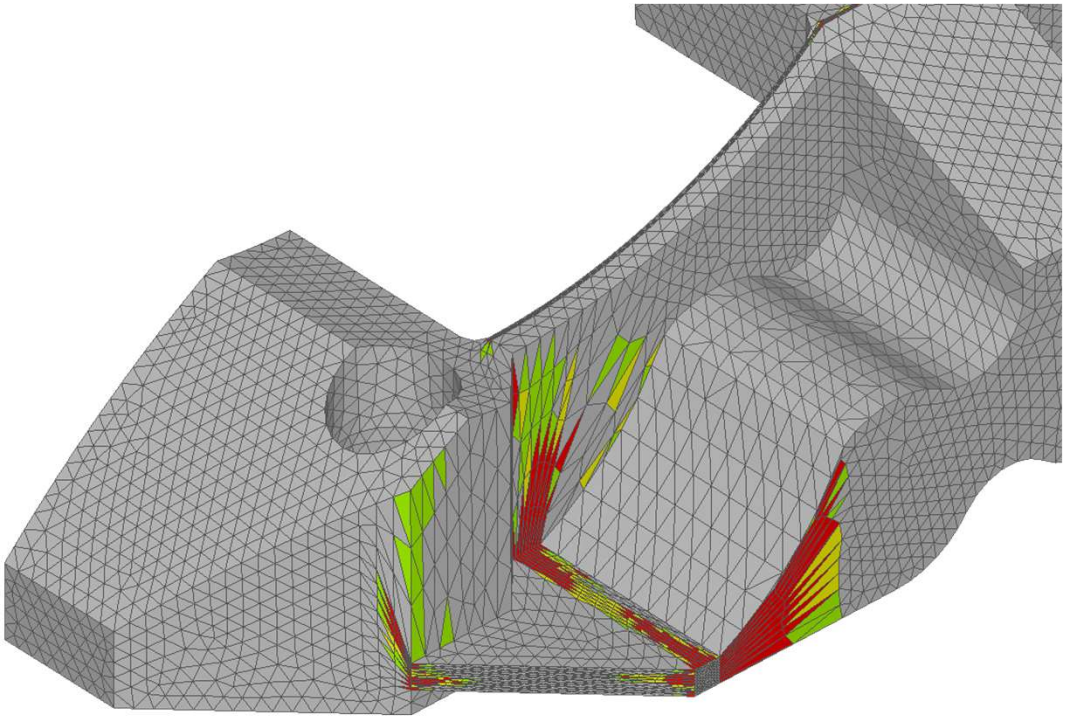

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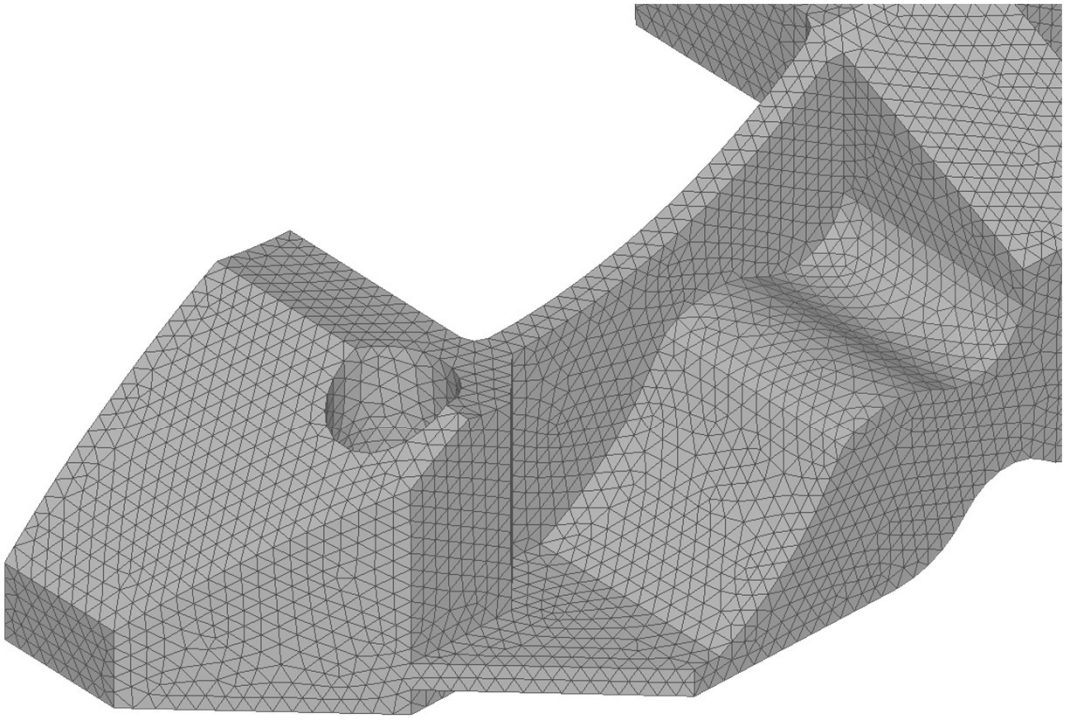
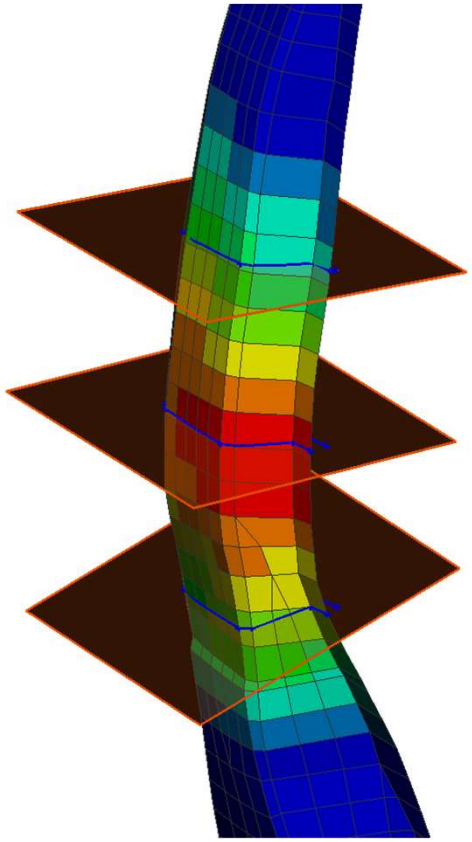


Functionalities assisting Morphing

Visualize Morphing Deviations

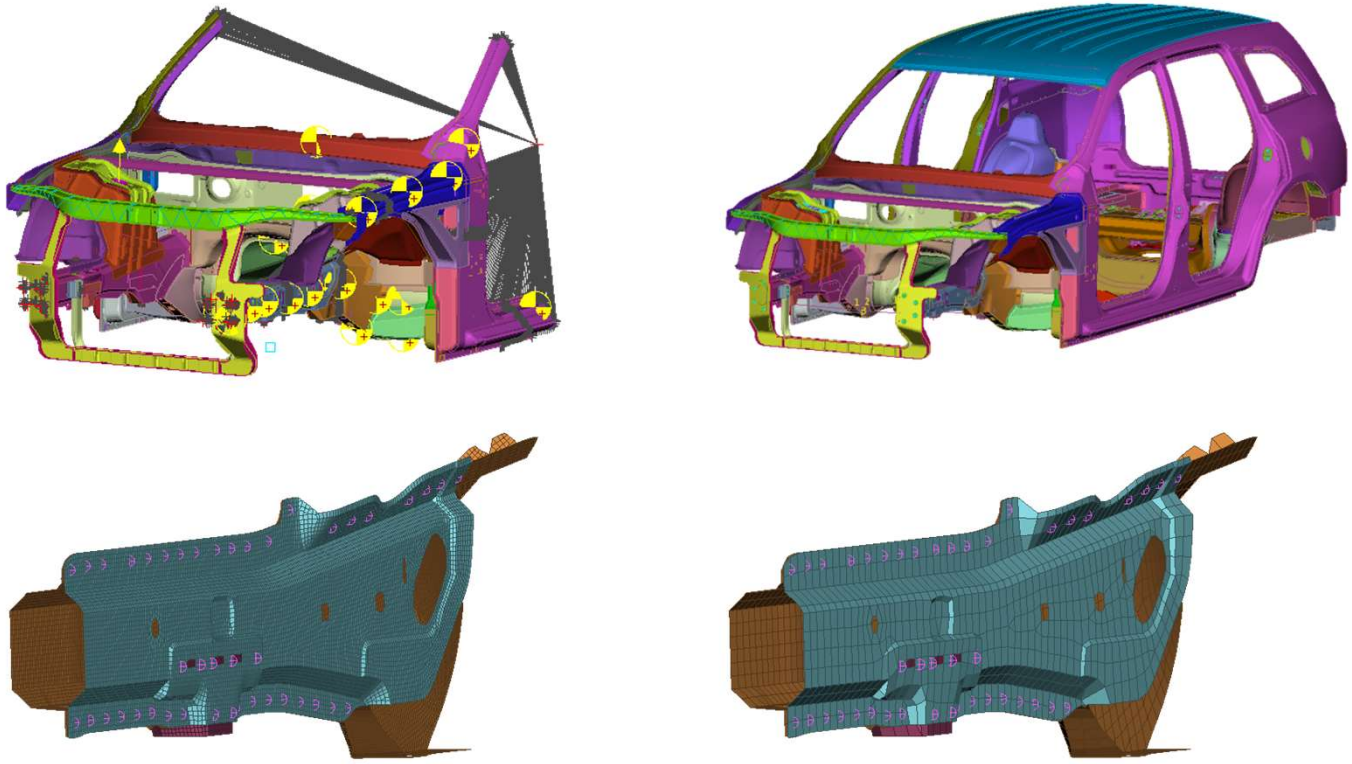
- Suitable for Box and Direct Morphing
- Measurement Tool
- Fringe Plot of deformed shape



Functionalities assisting Morphing

Design Migrate

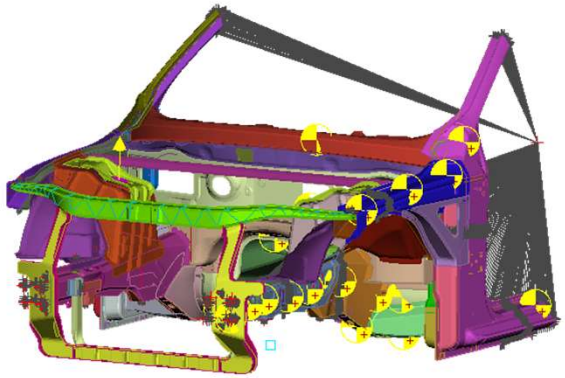
Re-application of Morph Parameters, Morph Constraints and Optimization Task items on different models

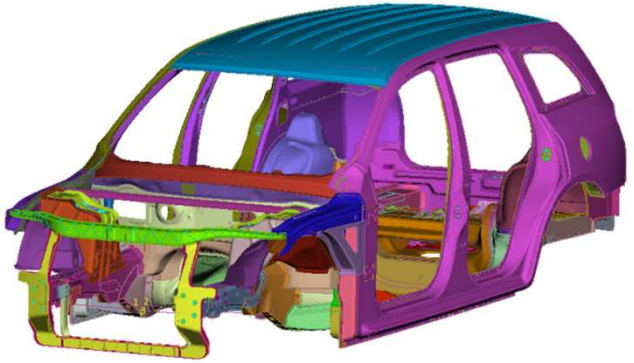


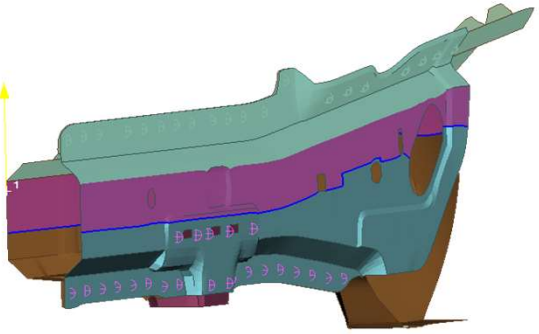
Functionalities assisting Morphing

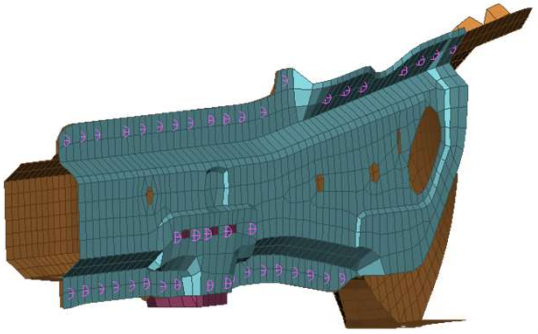
Design Migrate

Re-application of Morph Parameters, Morph Constraints and Optimization Task items on different models









Functionalities assisting Morphing

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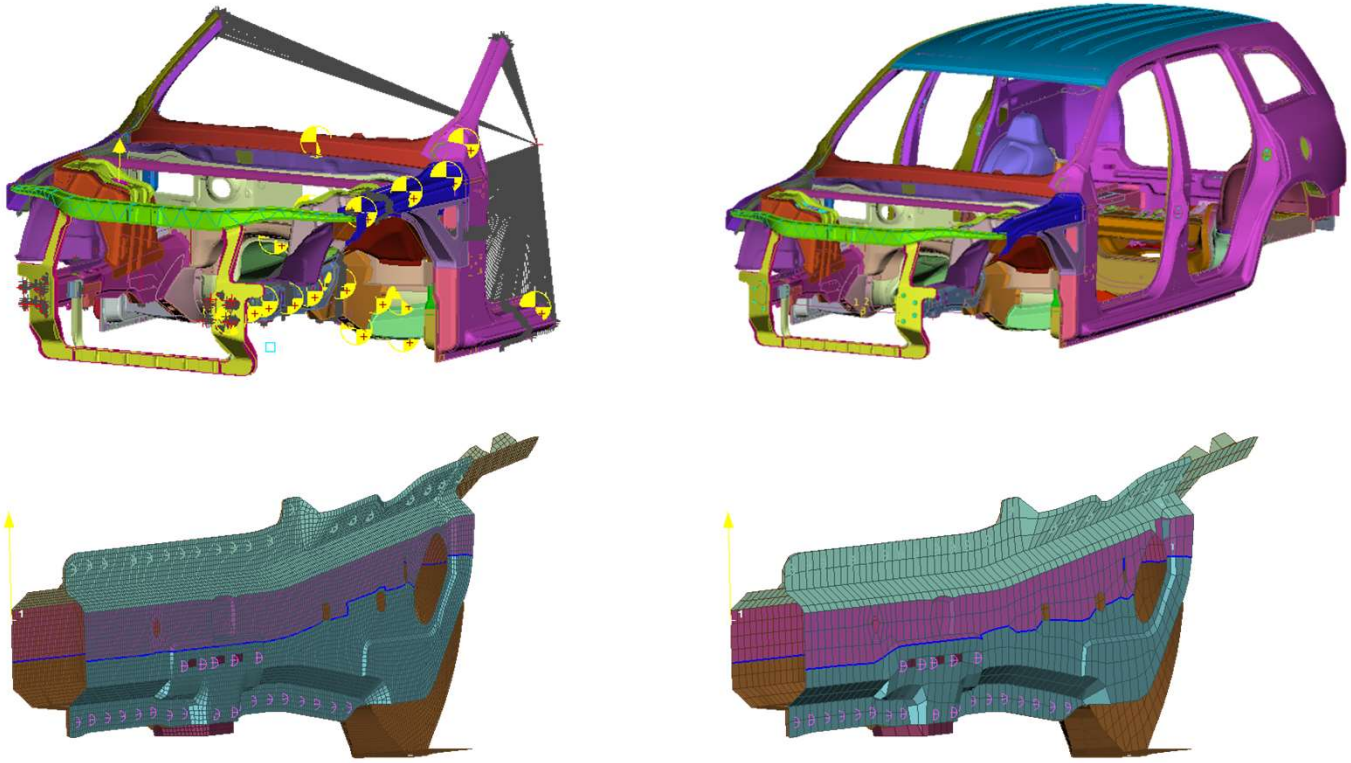
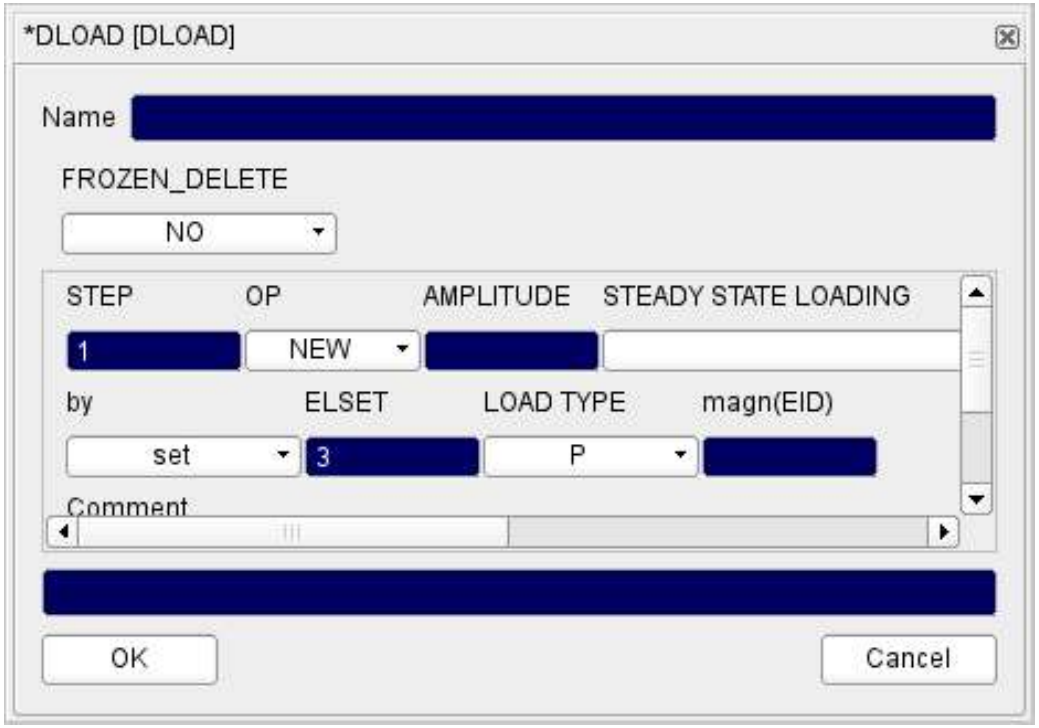


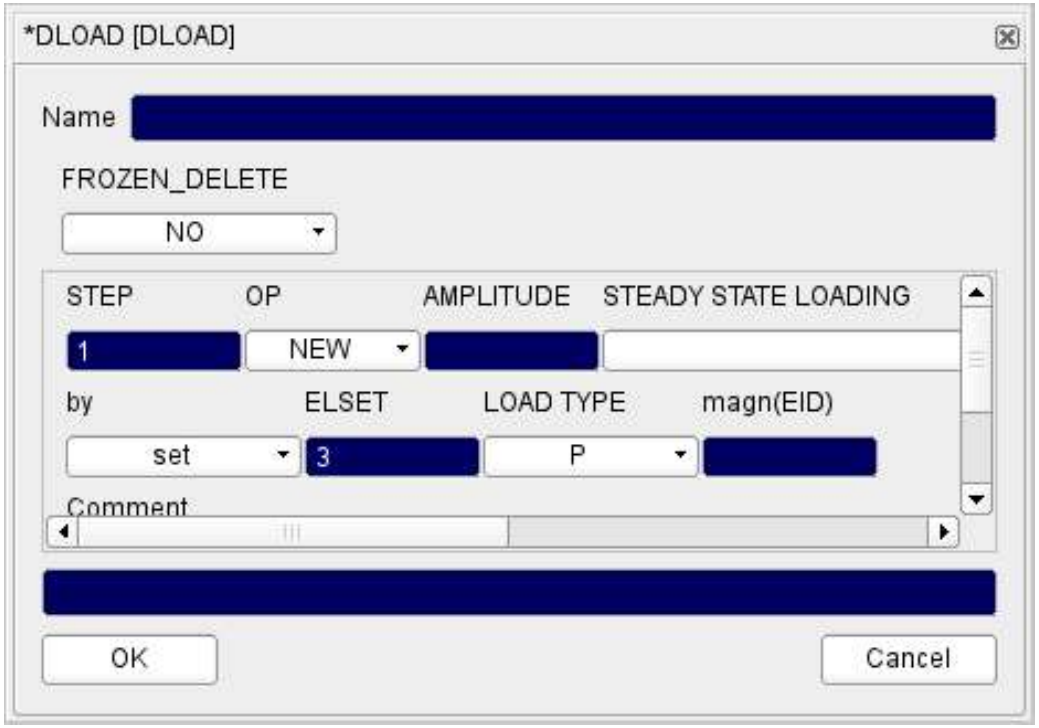
ANSA Parameter

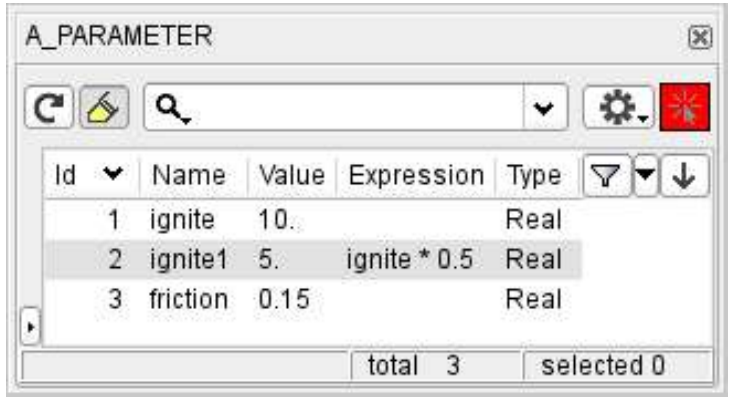
- For parameterization of solver card entries, e.g. thicknesses



ANSA Parameter

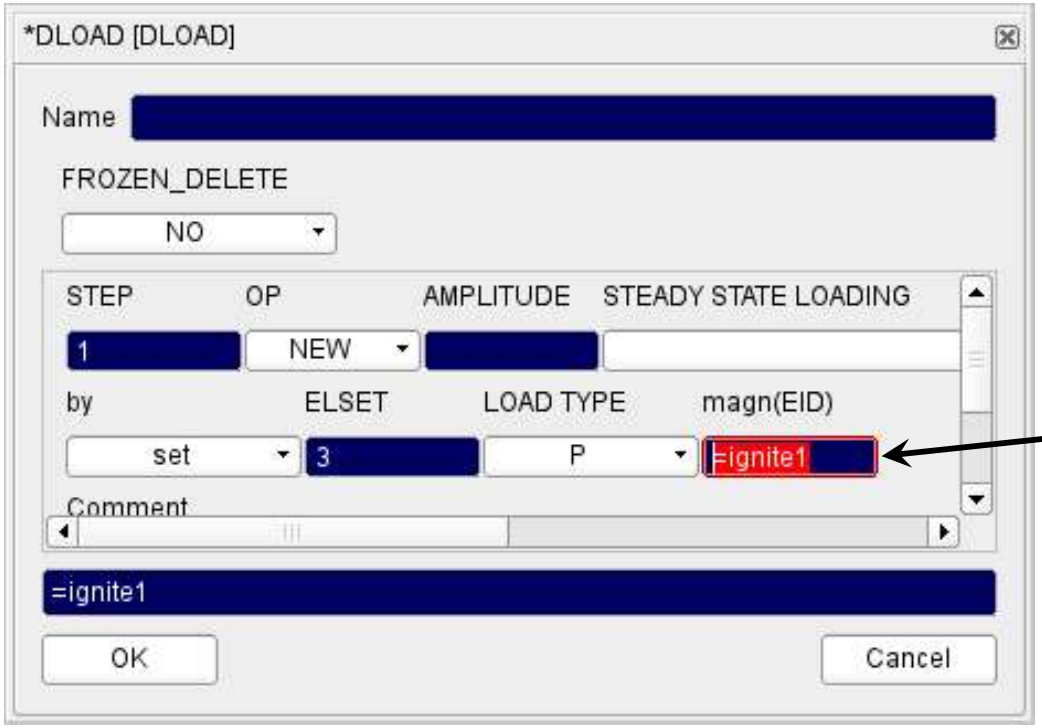
- For parameterization of solver card entries, e.g. thicknesses
- Different types; Expressions

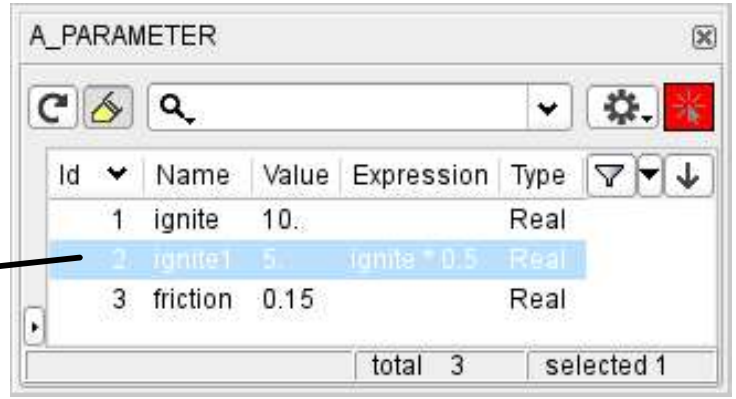




ANSA Parameter

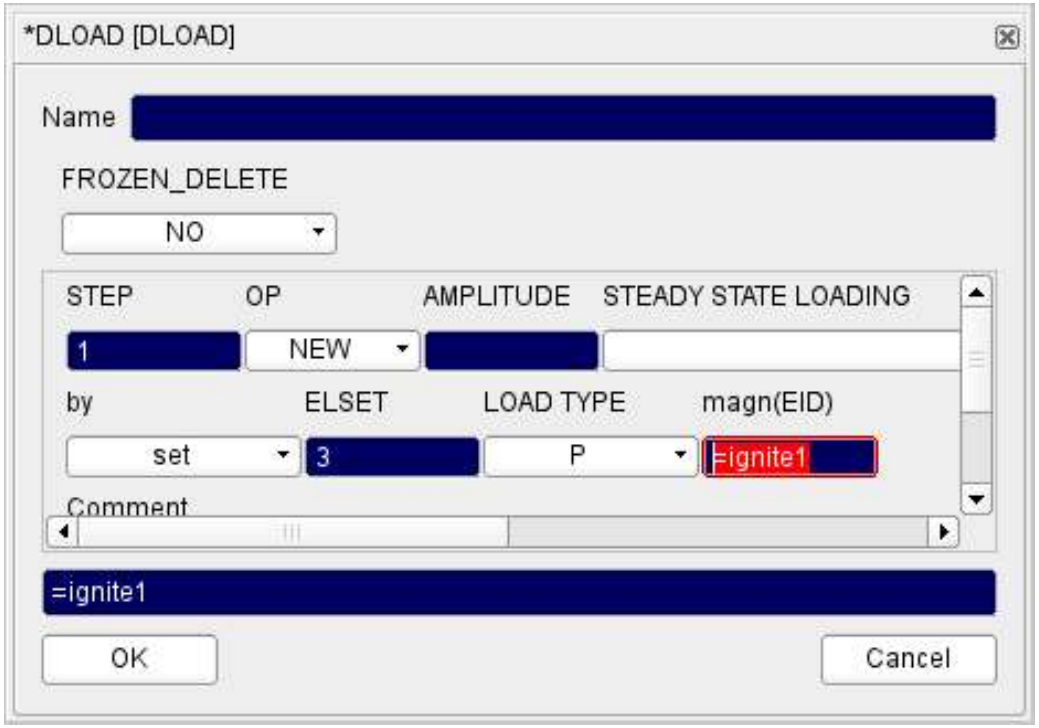
- For parameterization of solver card entries, e.g. thicknesses
- Different types; Expressions

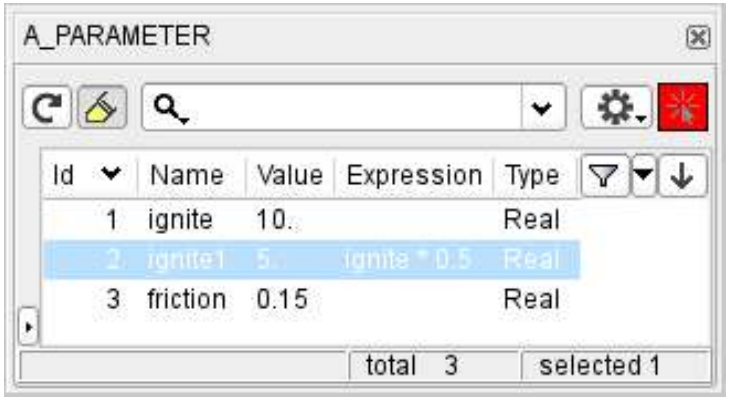




ANSA Parameter

- For parameterization of solver card entries, e.g. thicknesses
- Different types; Expressions
- Import from / Export to *PARAMETER






```
**
*PARAMETER
 ignite = 10.0
 ignite1 = ignite * 0.5
 friction = 0.15
**
**
*DSLOAD, OP=NEW
  S_zkd_zuenden_zy6,   P, <ignite1>
  S_brennraum_zy6,   P, <ignite>
```

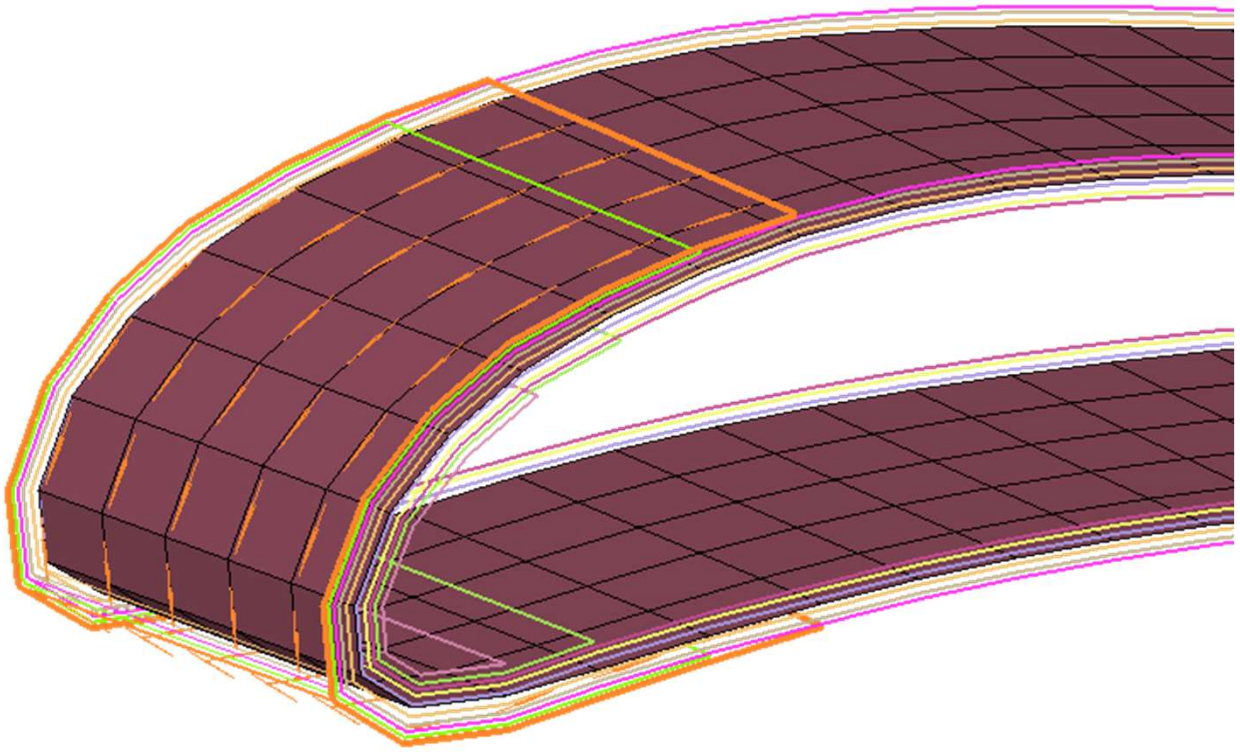
ANSA Parameter

- For parameterization of composite properties, e.g.:

Layers

PID	Z0	NSM	S
1			

A/A	Type	T	THETA	m
1	Sequence			
1	Layer	0.2	90.	
2	Layer	0.1	-45.	
3	Layer	0.1	45.	
4	Layer	0.2	0.	
5	Layer	0.2	0.	
6	Layer	0.1	45.	
7	Layer	0.1	-45.	
8	Layer	0.2	90.	



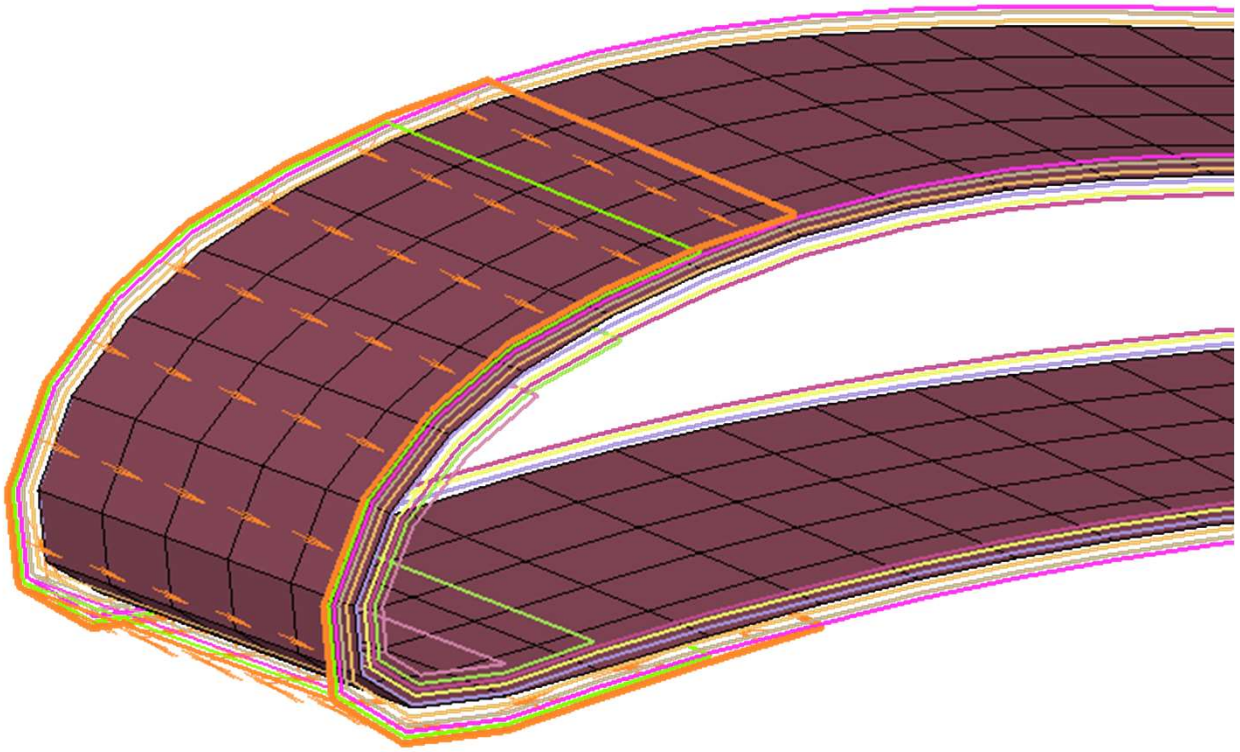
ANSA Parameter

- For parameterization of composite properties, e.g.:
  - fabric orientation

Layers

PID	Z0	NSM	S
1			

A/A	Type	T	THETA	m
1	Sequence			
1	Layer	0.2	90.	
2	Layer	0.1	-45.	
3	Layer	0.1	45.	
4	Layer	0.2	0.	
5	Layer	0.2	0.	
6	Layer	0.1	45.	
7	Layer	0.1	-45.	
8	Layer	0.2	90.	



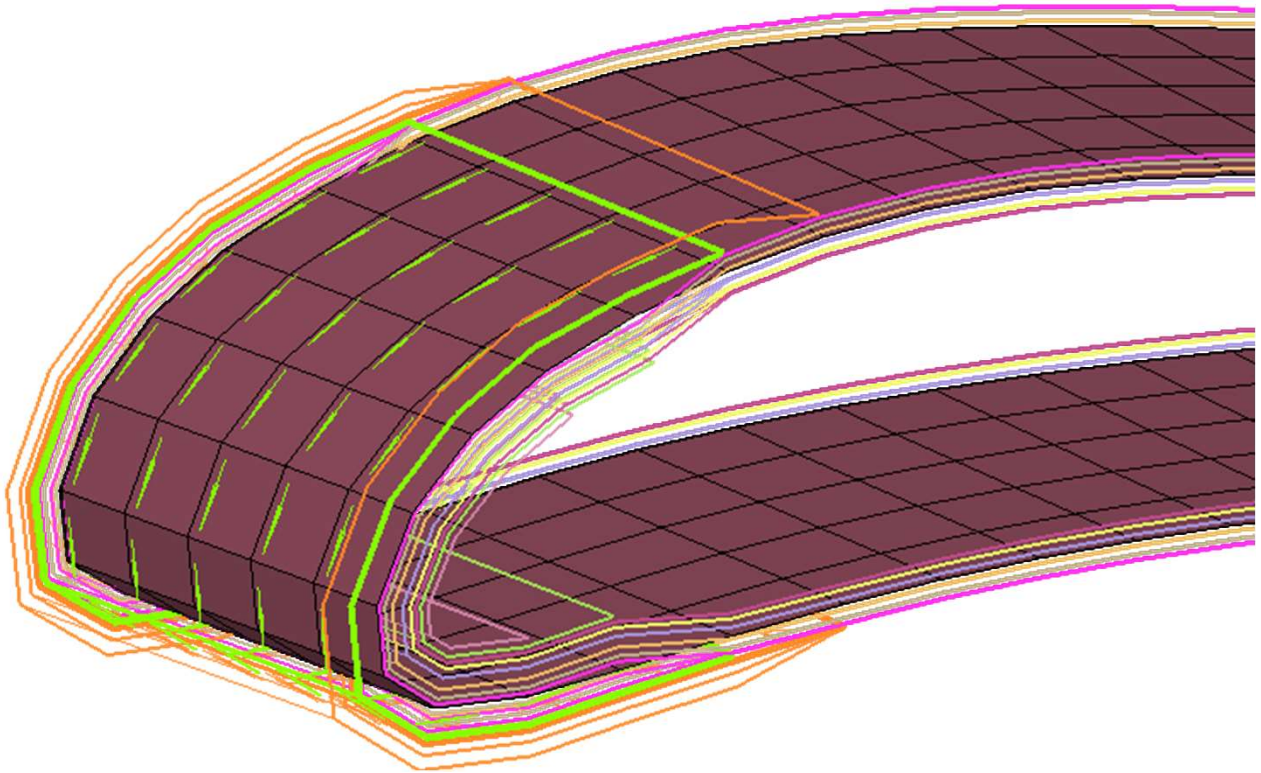
ANSA Parameter

- For parameterization of composite properties, e.g.:
  - fabric orientation
  - layer thickness

Layers

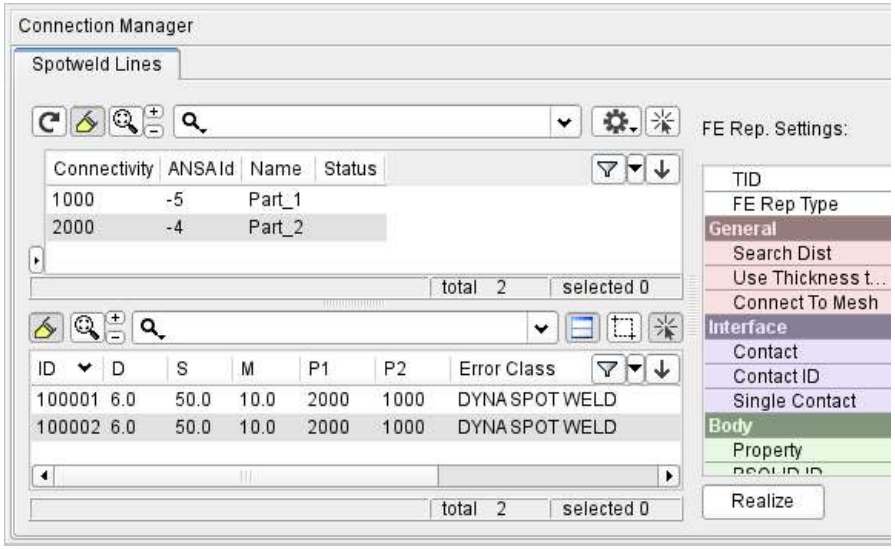
PID	Z0	NSM	S
1			

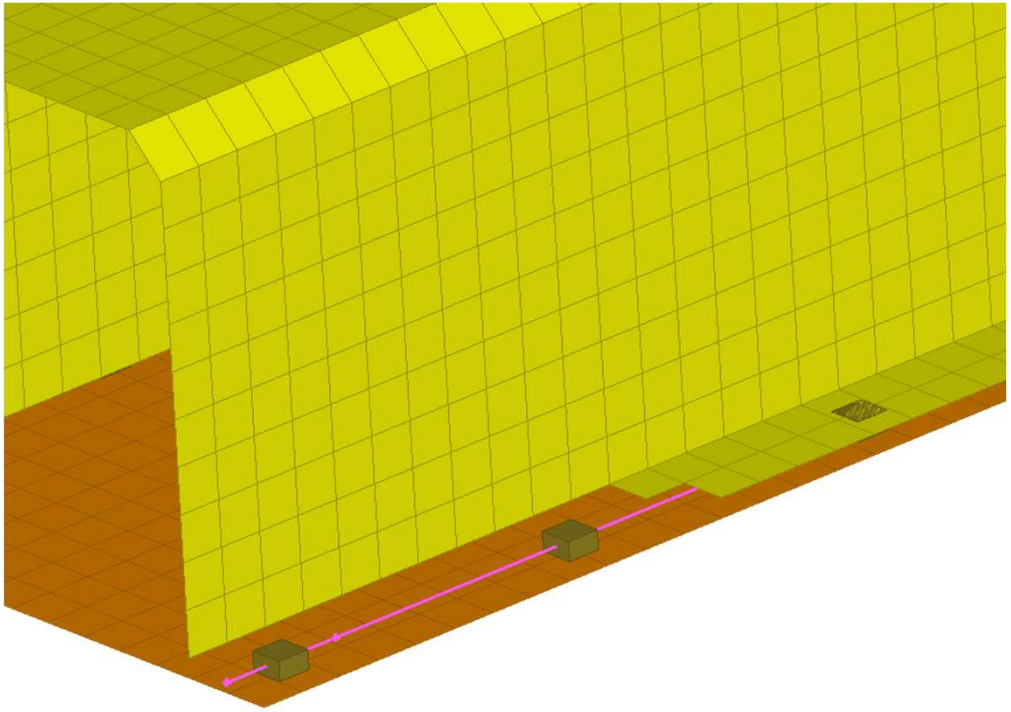
A/A	Type	T	THETA	m
1	Sequence			
1	Layer	0.2	90.	
2	Layer	0.1	-45.	
3	Layer	0.1	45.	
4	Layer	0.2	0.	
5	Layer	0.2	0.	
6	Layer	0.1	45.	
7	Layer	0.1	-45.	
8	Layer	0.2	90.	



ANSA Parameter

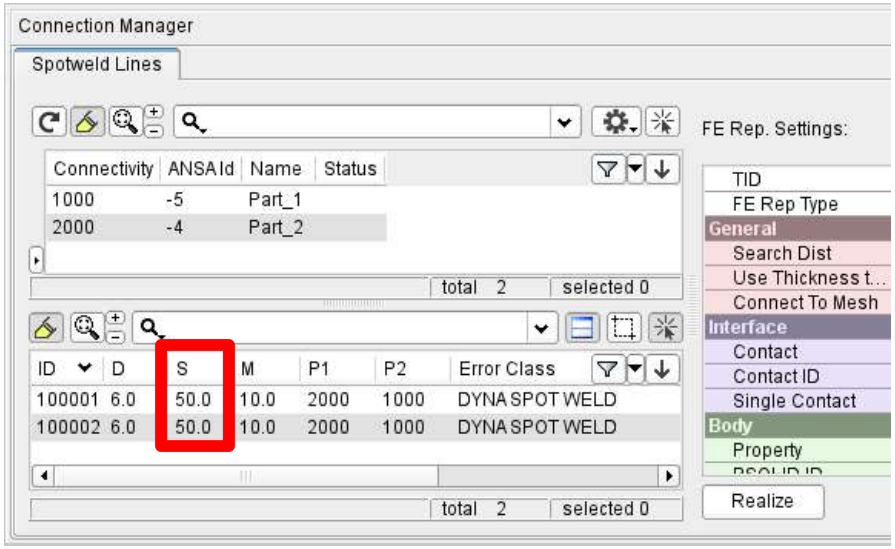
- For parameterization of connection properties, e.g.:

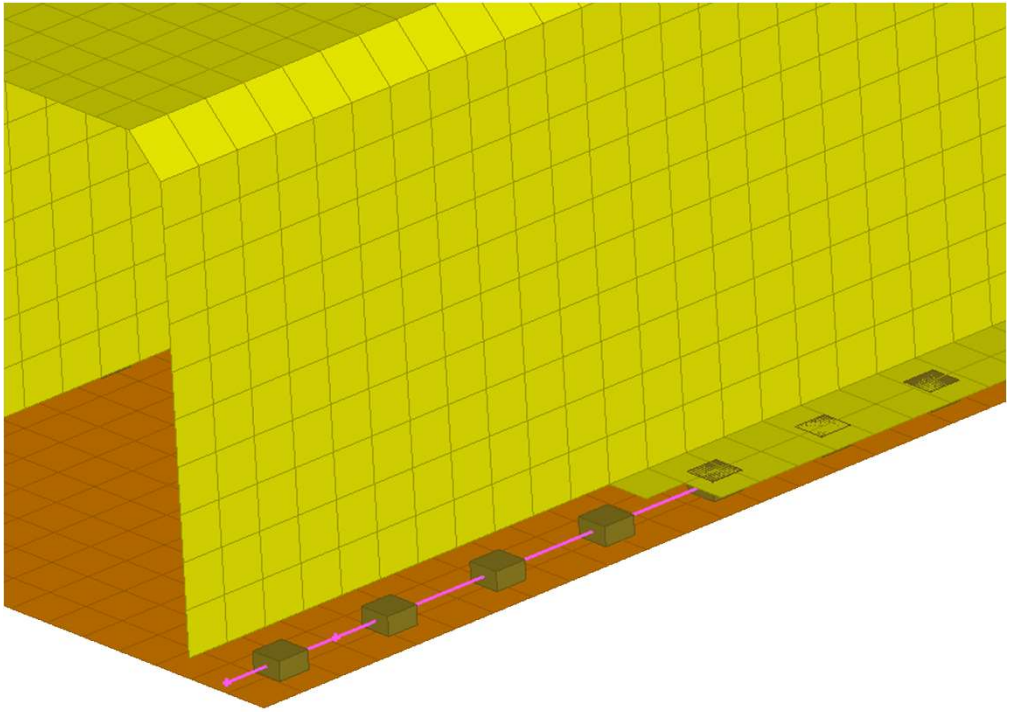




ANSA Parameter

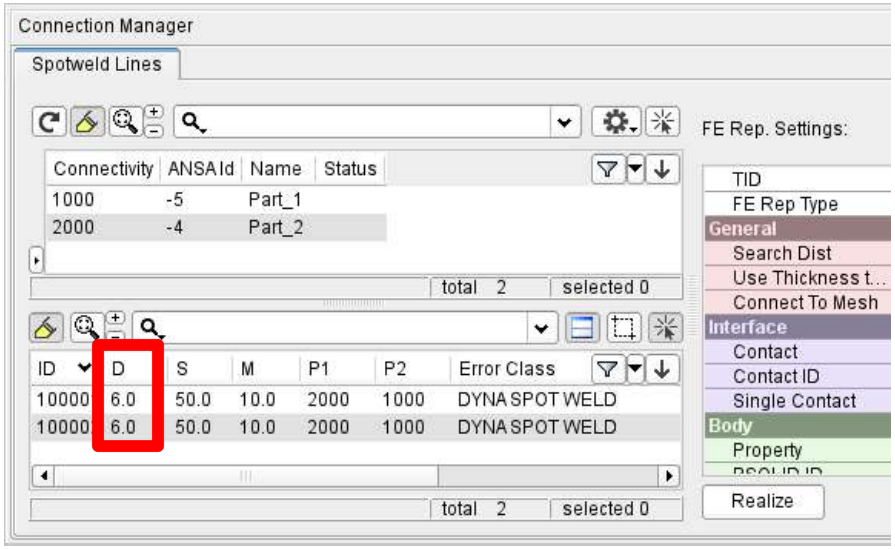
- For parameterization of connection properties, e.g.:
  - distance between weld spots

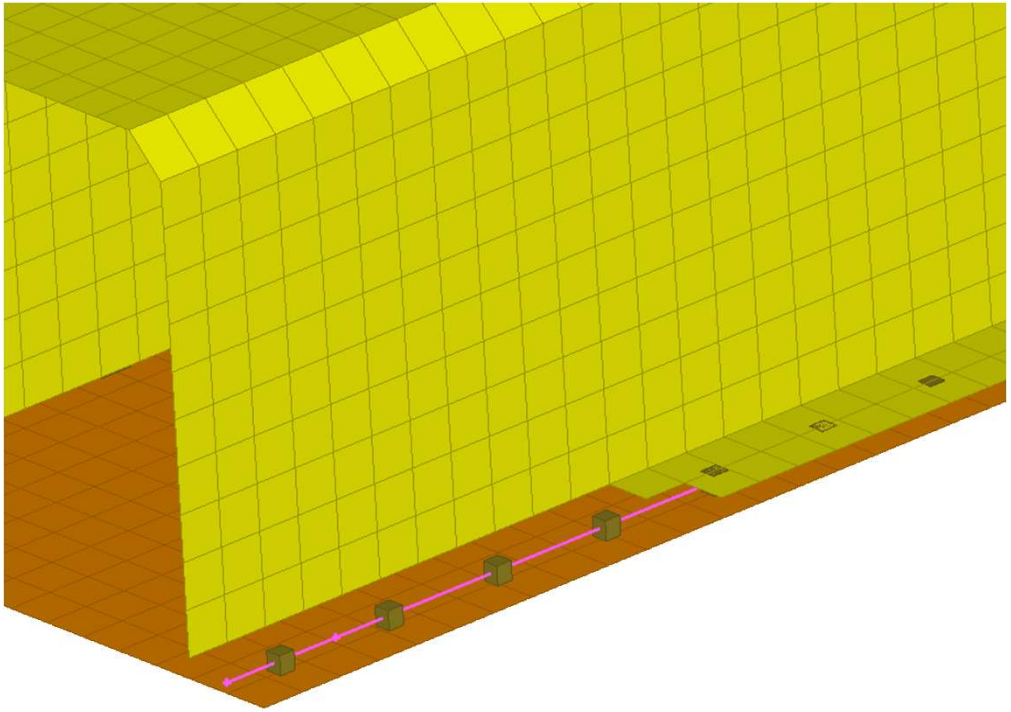




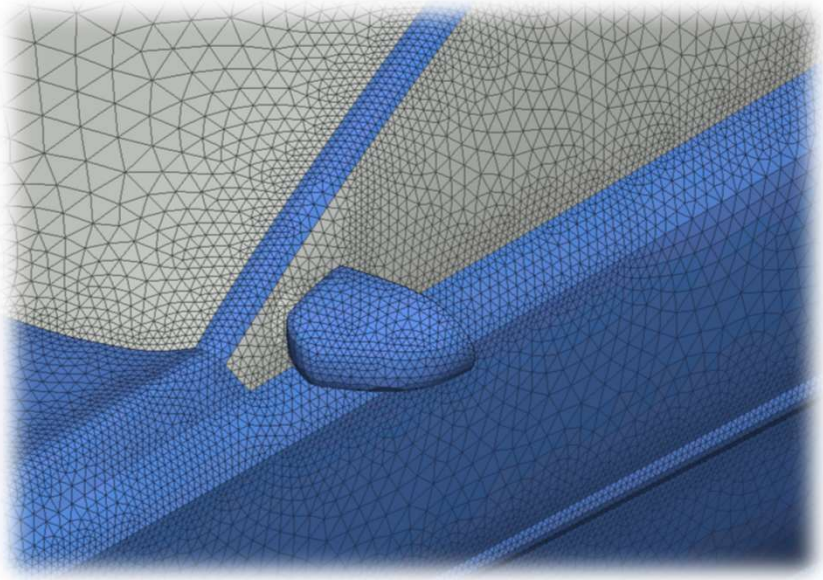
ANSA Parameter

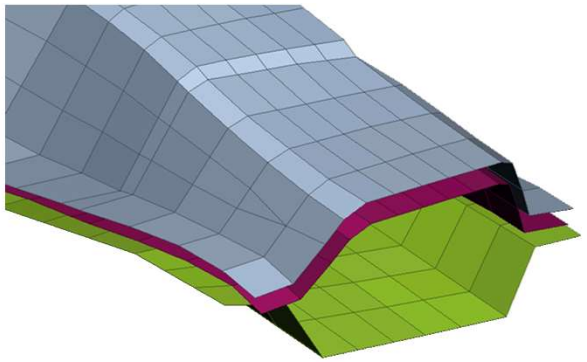
- For parameterization of connection properties, e.g.:
  - distance between weld spots
  - diameter of weld spots

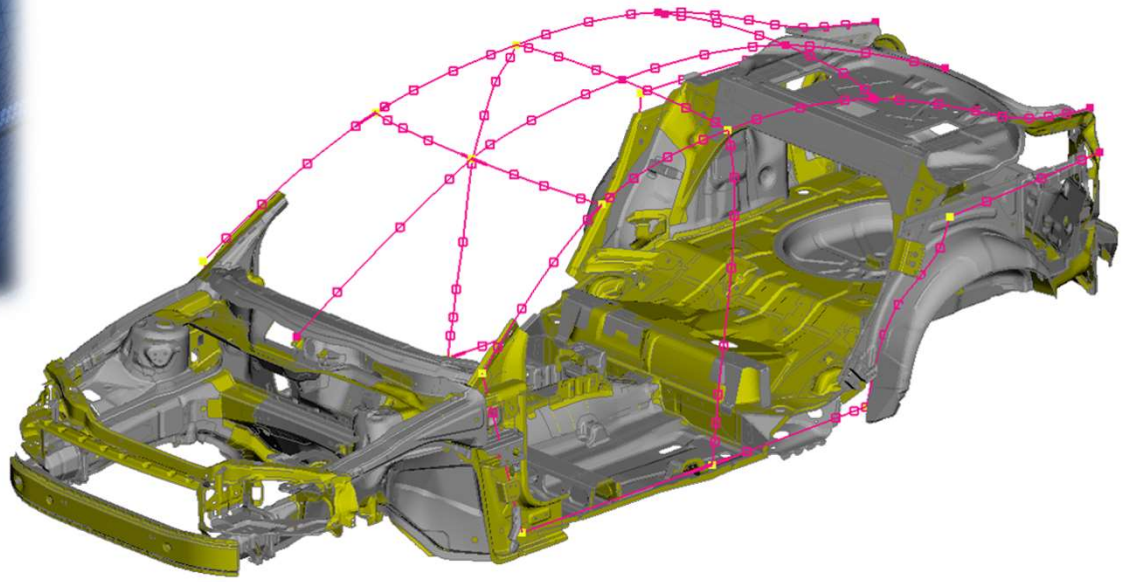




Ευχαριστώ πολύ







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