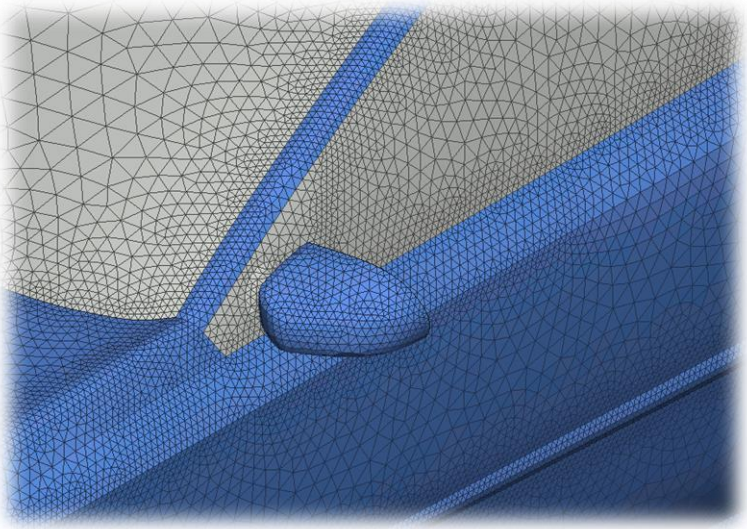
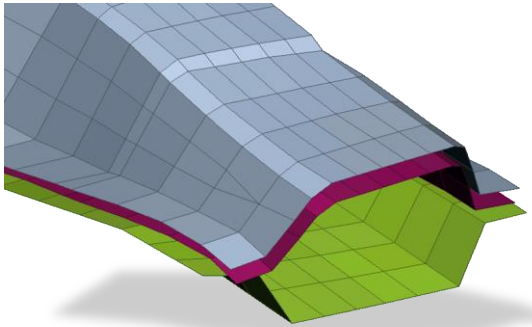
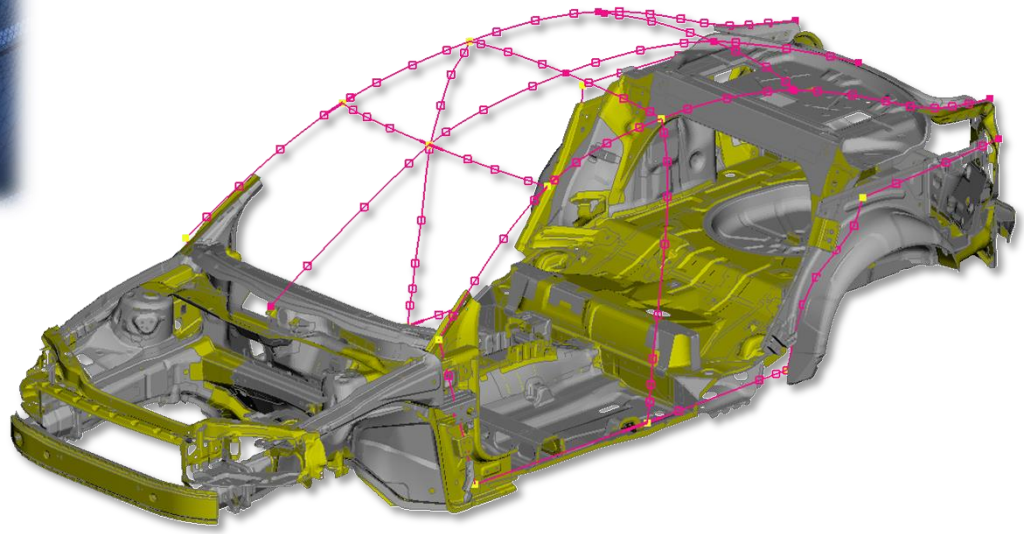
# Model Parameterization in ANSA



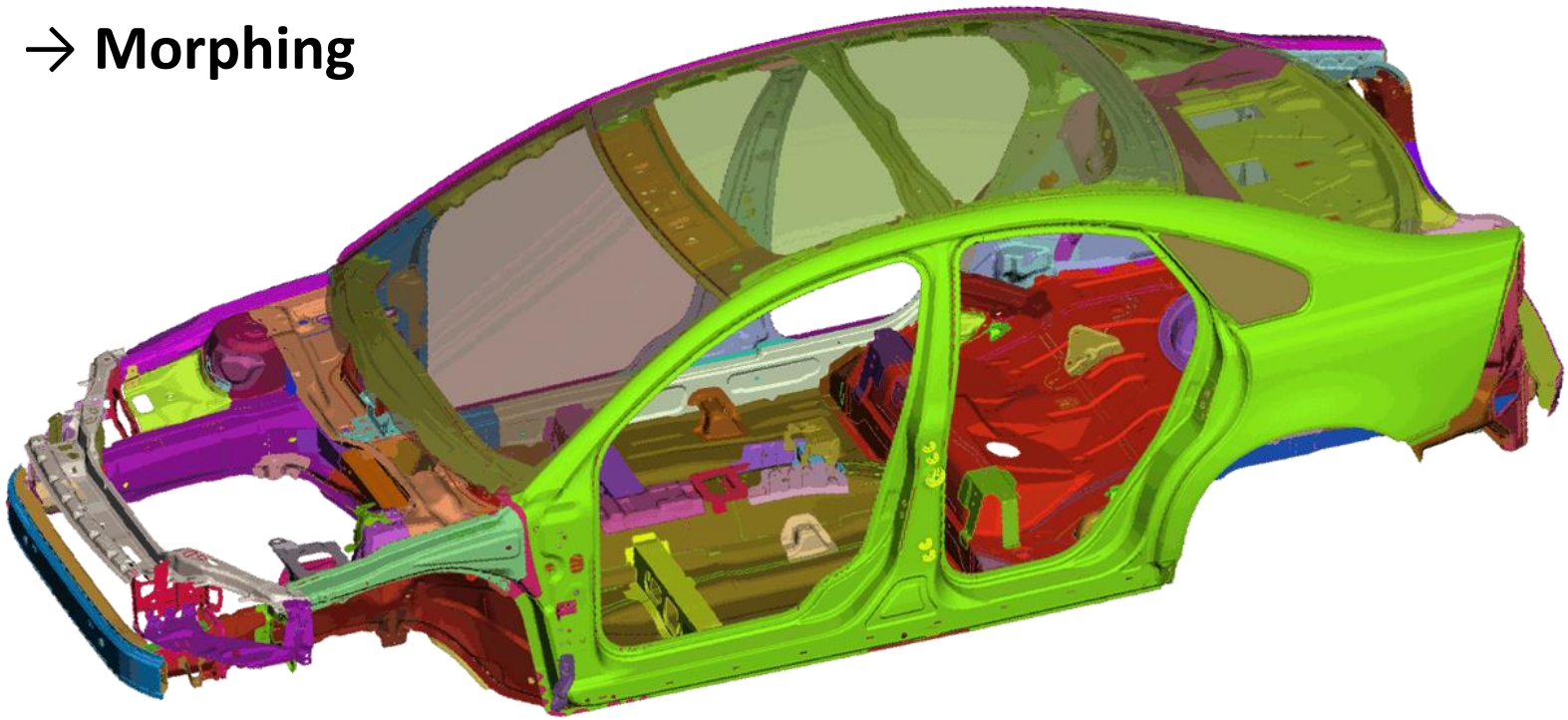




Dirk Dreißig
Mail: ansa@lasso.de

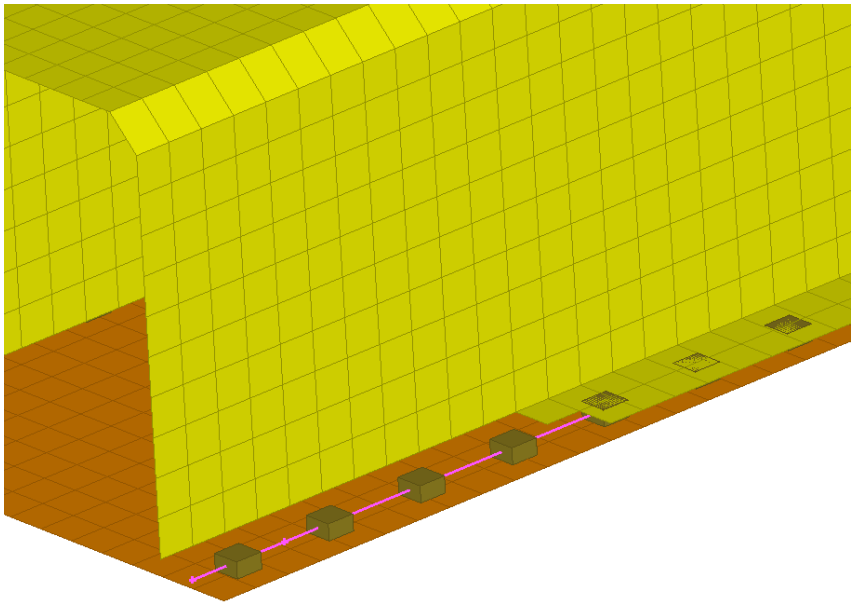
# Types of Parameterization

- Shape modification
  → **Morphing**



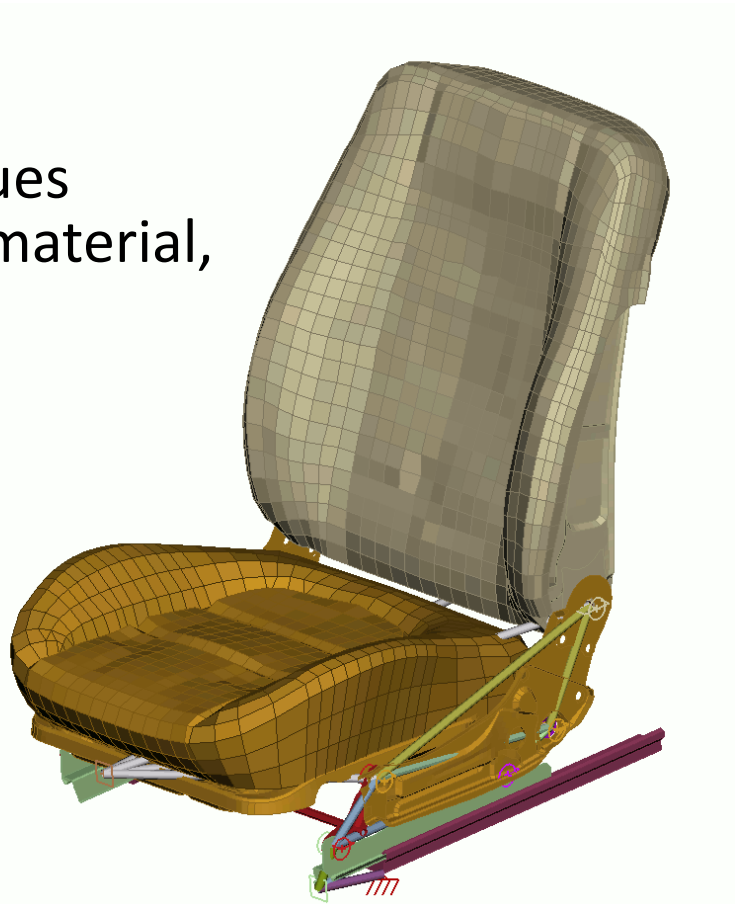
# Types of Parameterization

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



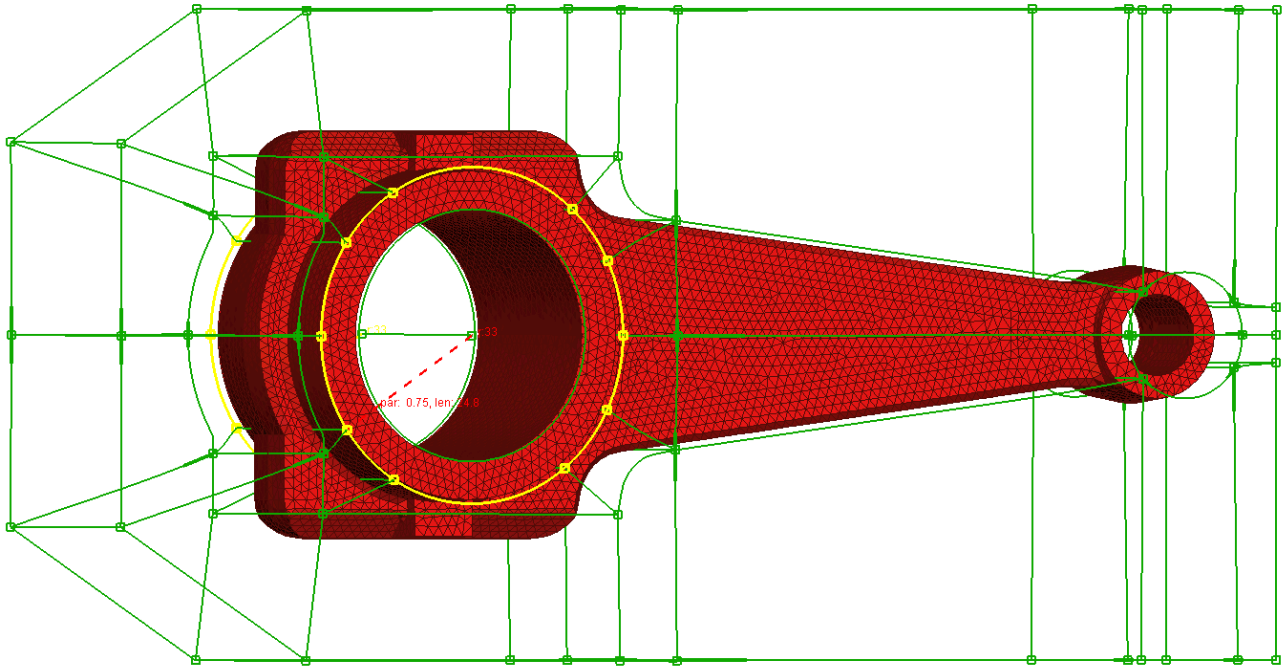
# Types of Parameterization

- 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**



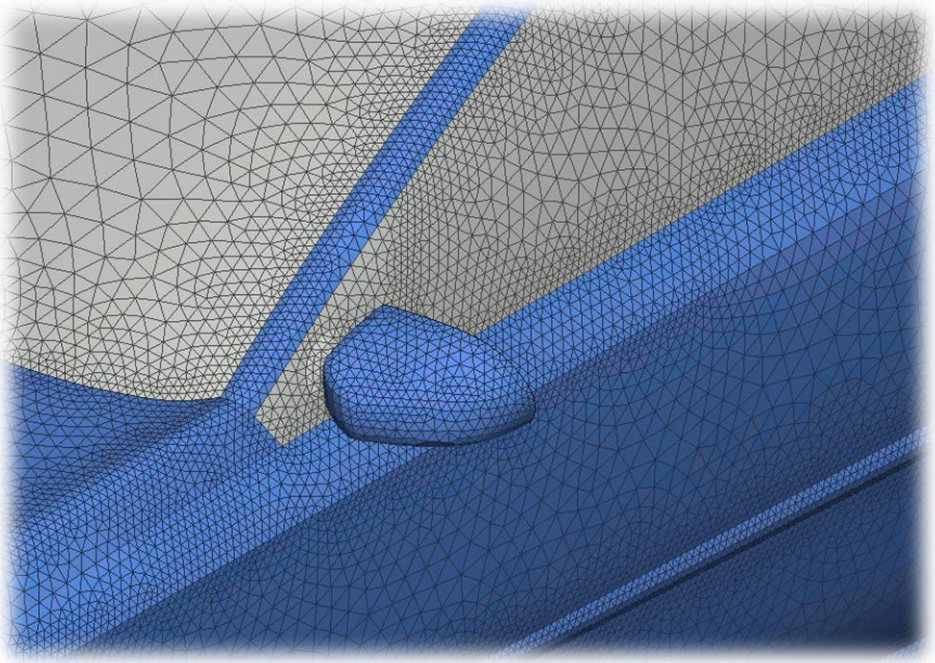
# Morphing

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



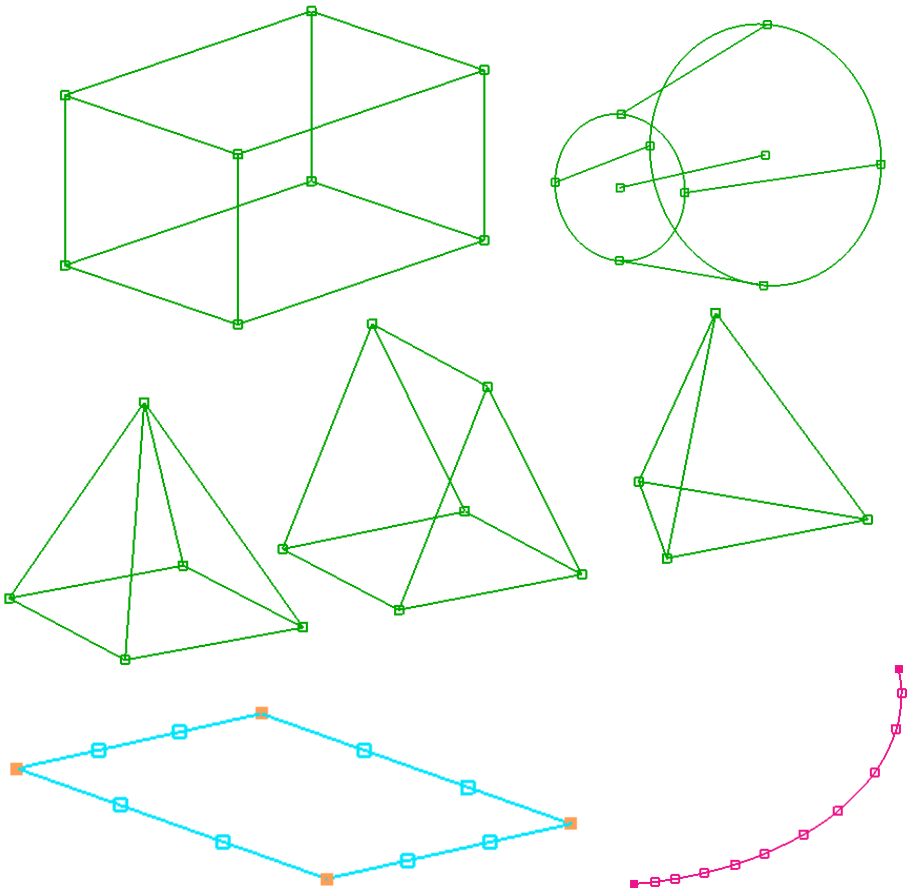
# Morphing

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



# Box Morphing

## Types of boxes

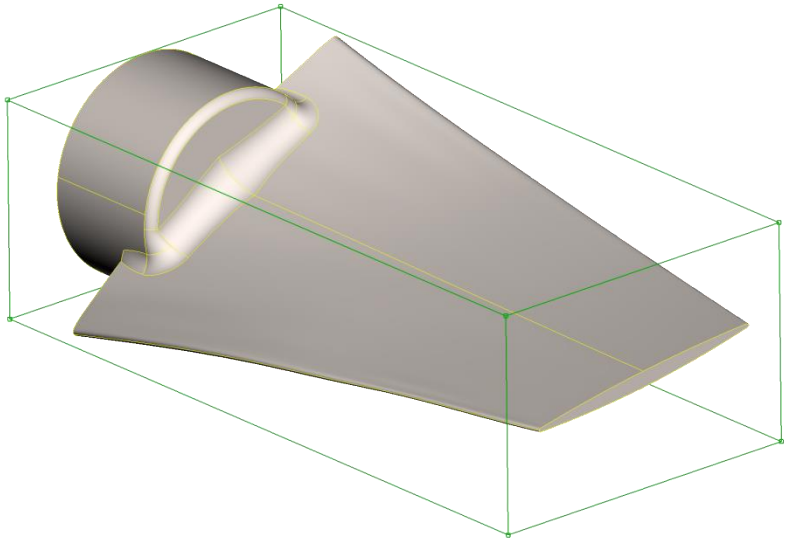


- 3D
  - Hexa
  - Penta
  - Tetra
  - Pyramid
  - Cylindrical
- 2D (specific thickness)
- 1D (specific diameter)

# Box Morphing

## How to create?

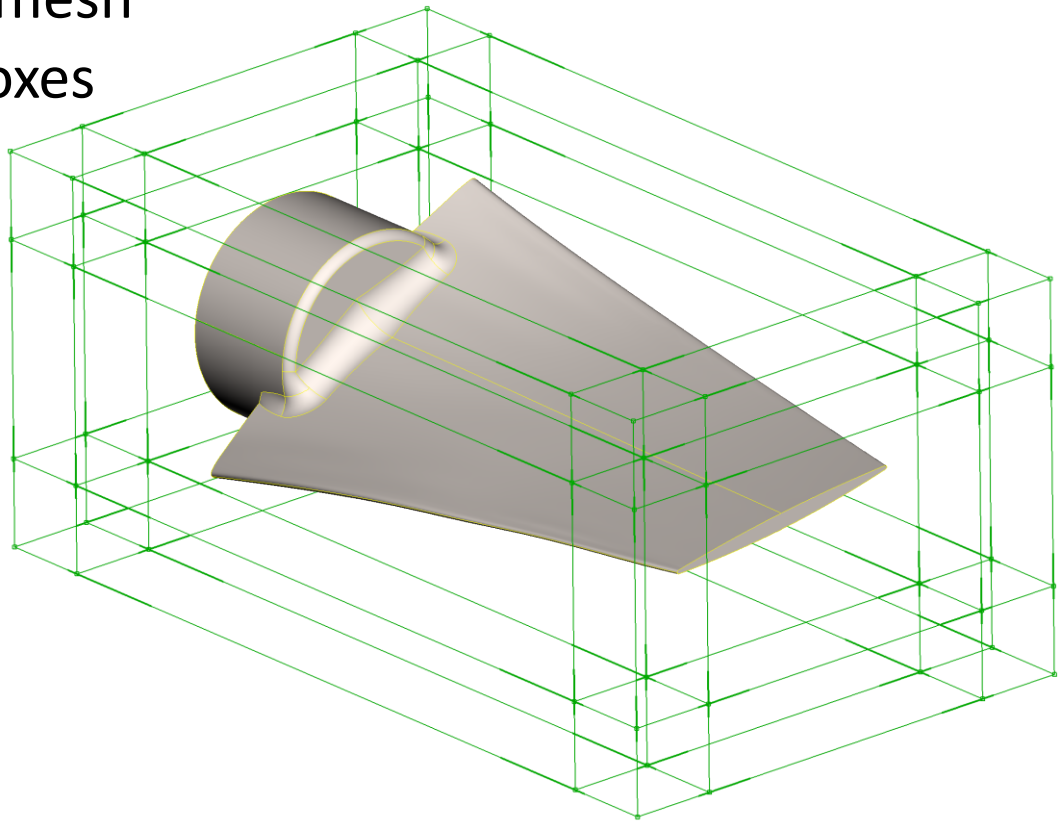
- Around geometry / mesh



# Box Morphing

## How to create?

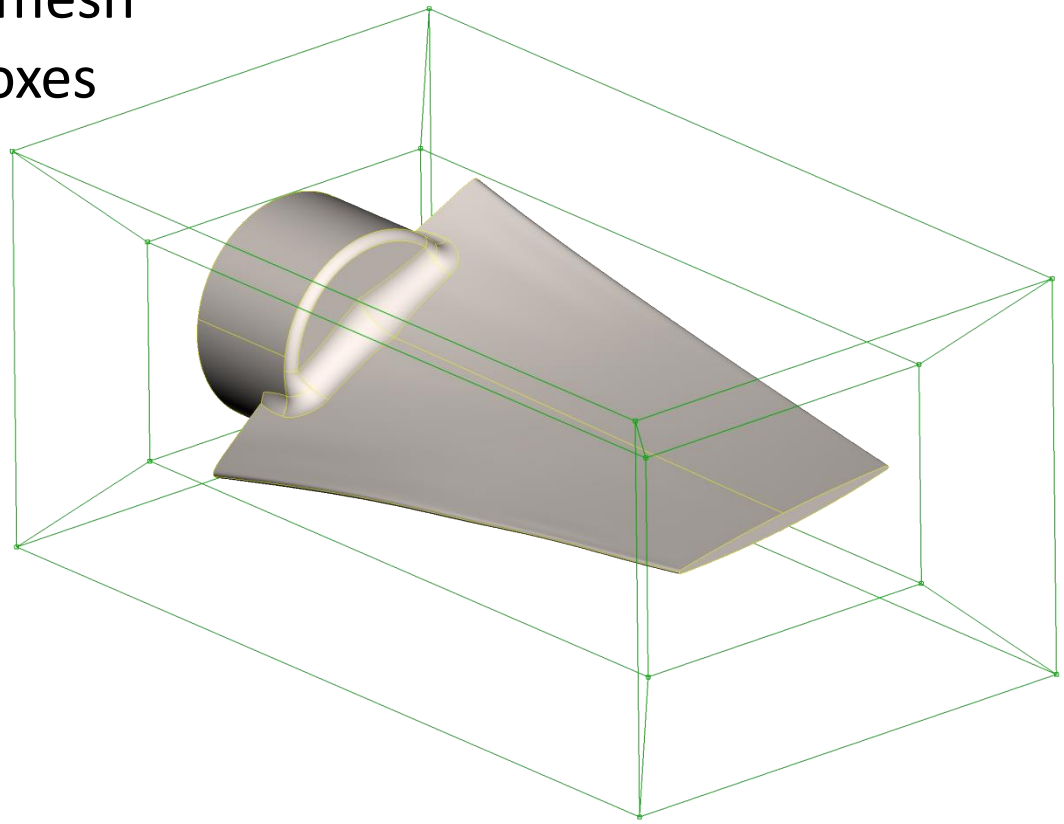
- Around geometry / mesh
- Offset on existing boxes



# Box Morphing

## How to create?

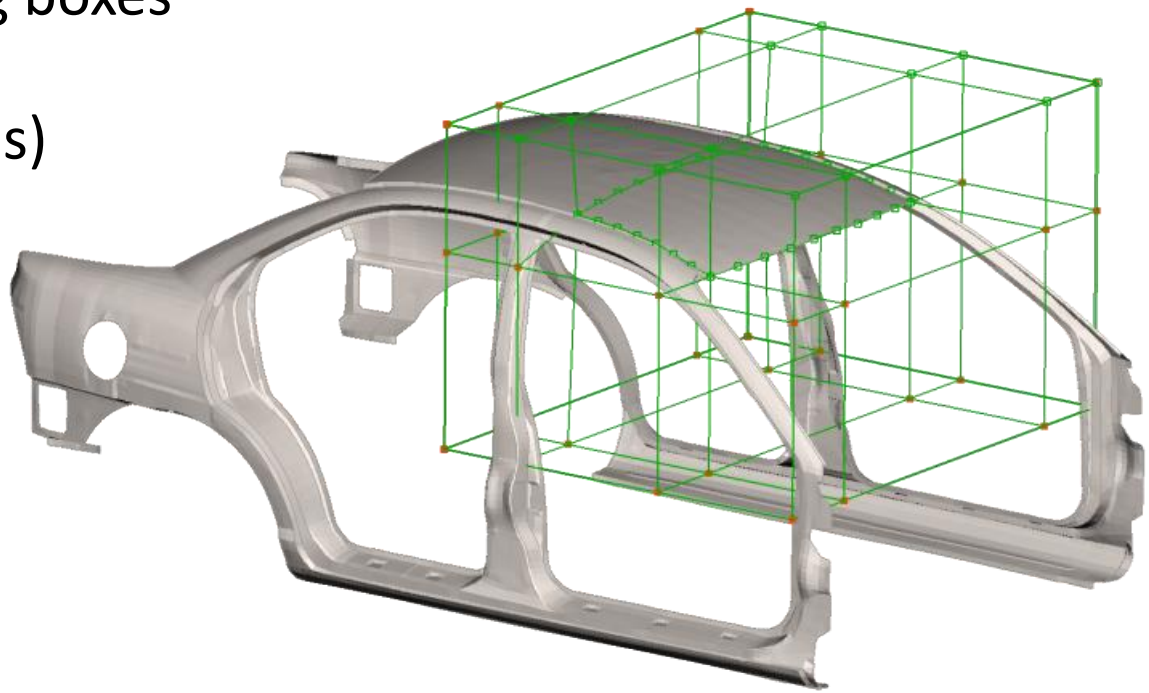
- Around geometry / mesh
- Offset on existing boxes



# Box Morphing

## How to create?

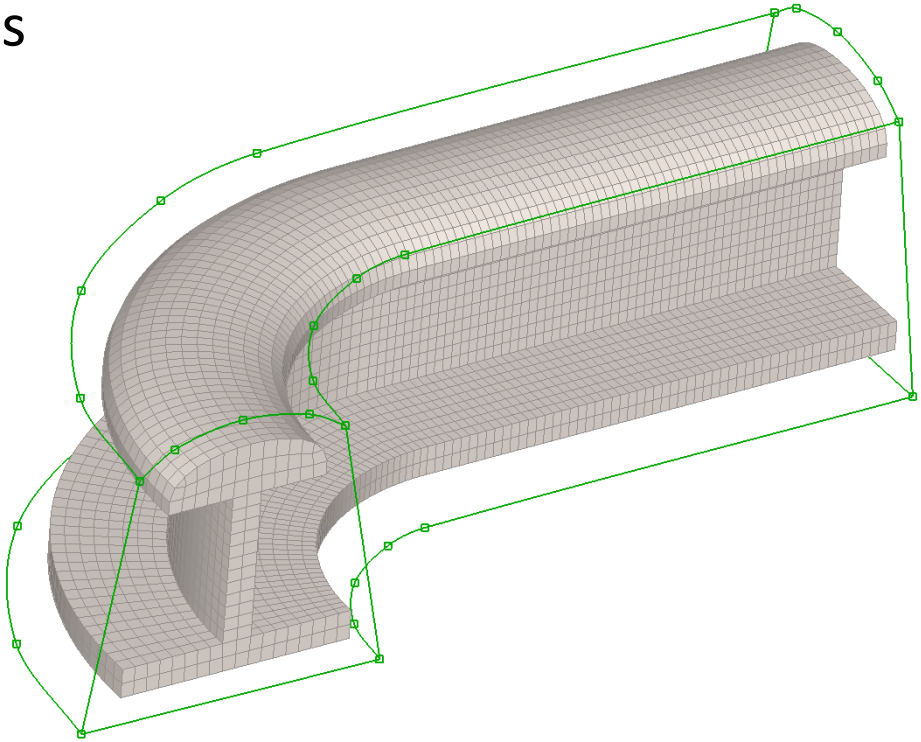
- Around geometry / mesh
- Offset on existing boxes
- Split + Fit
  (edges or surfaces)



# Box Morphing

## How to create?

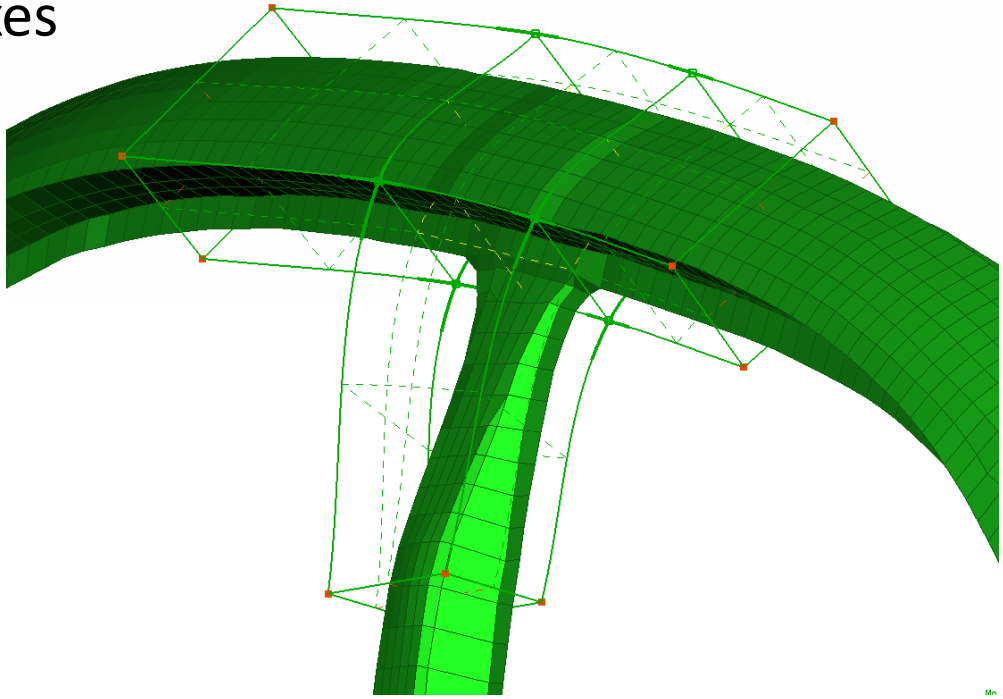
- Around geometry / mesh
- Offset on existing boxes
- Split + Fit
  (edges or surfaces)
- Sweep / Glide



# Box Morphing

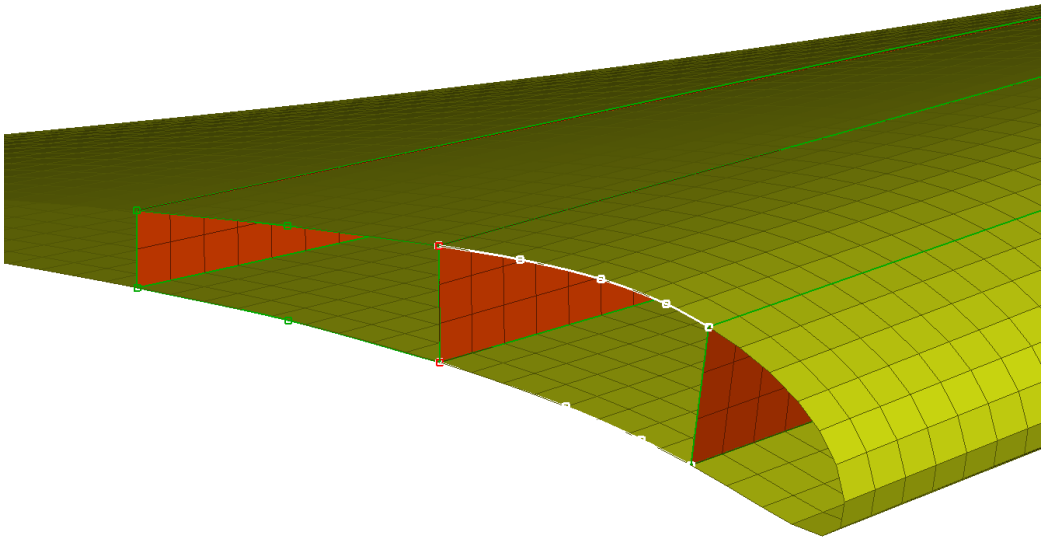
## How to create?

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



# Box Morphing

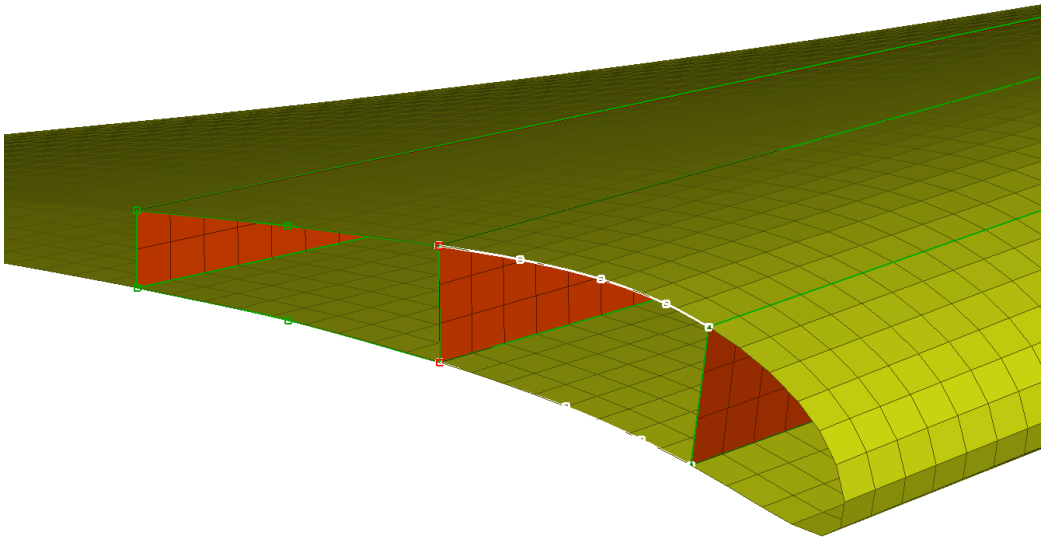
## How to modify?



# Box Morphing

## How to modify?

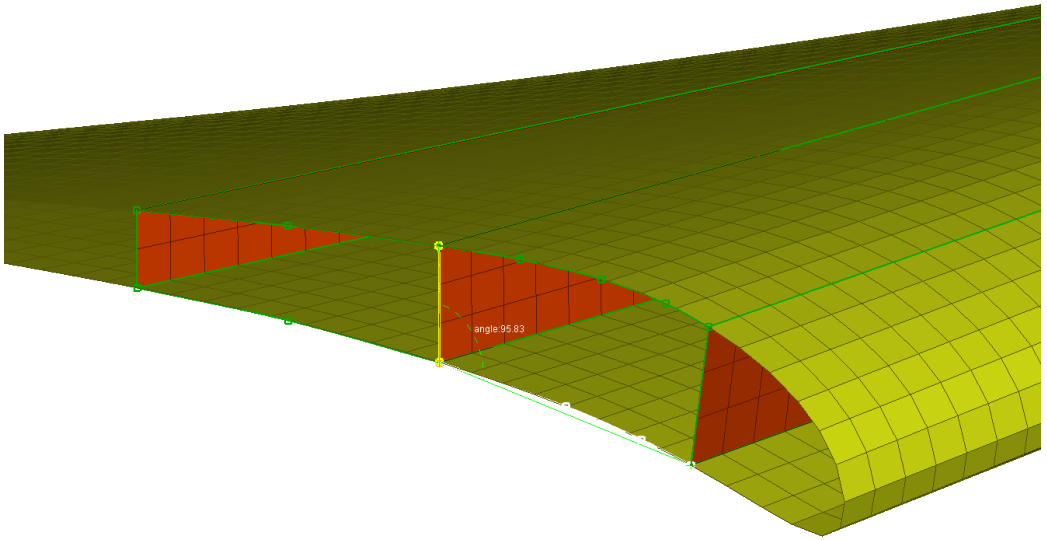
- Move (Translate, Rotate)
- Slide / Extend



# Box Morphing

## How to modify?

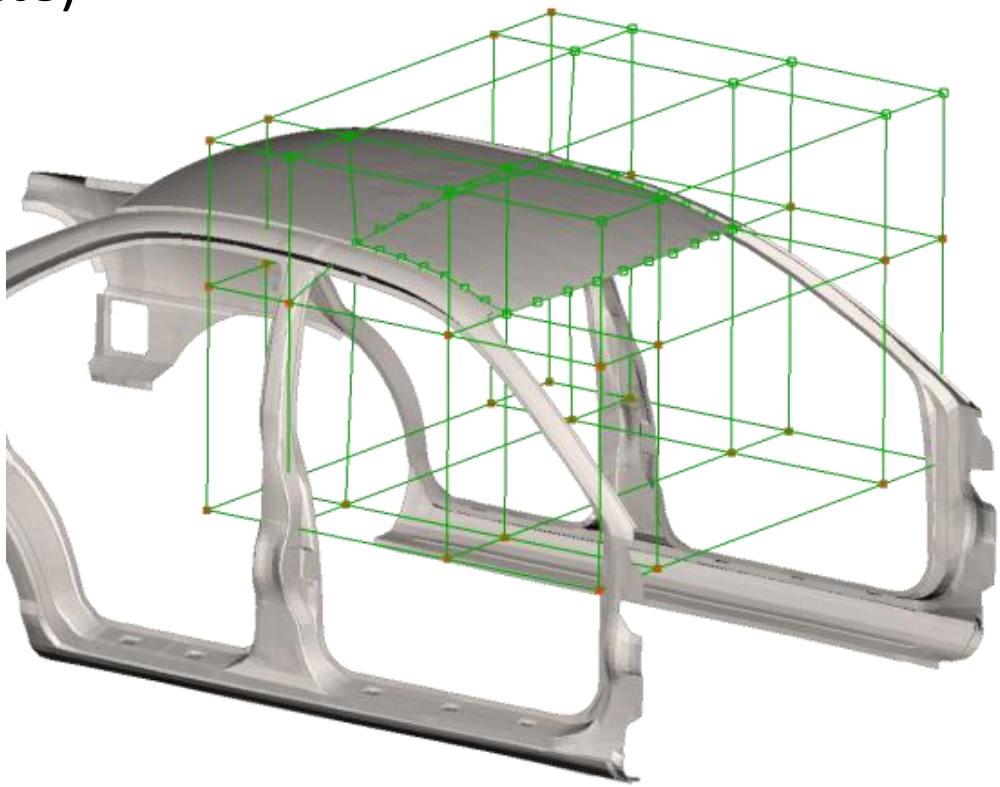
- Move (Translate, Rotate)
- Slide / Extend
- Angle



# Box Morphing

## How to modify?

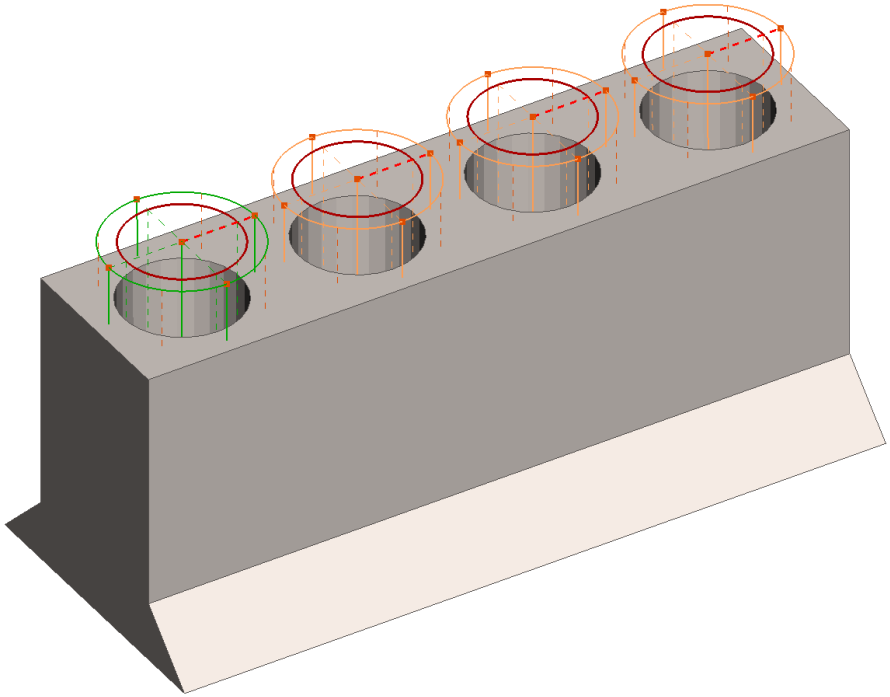
- Move (Translate, Rotate)
- Slide / Extend
- Angle
- Fit (edges, surfaces)



# Box Morphing

## How to modify?

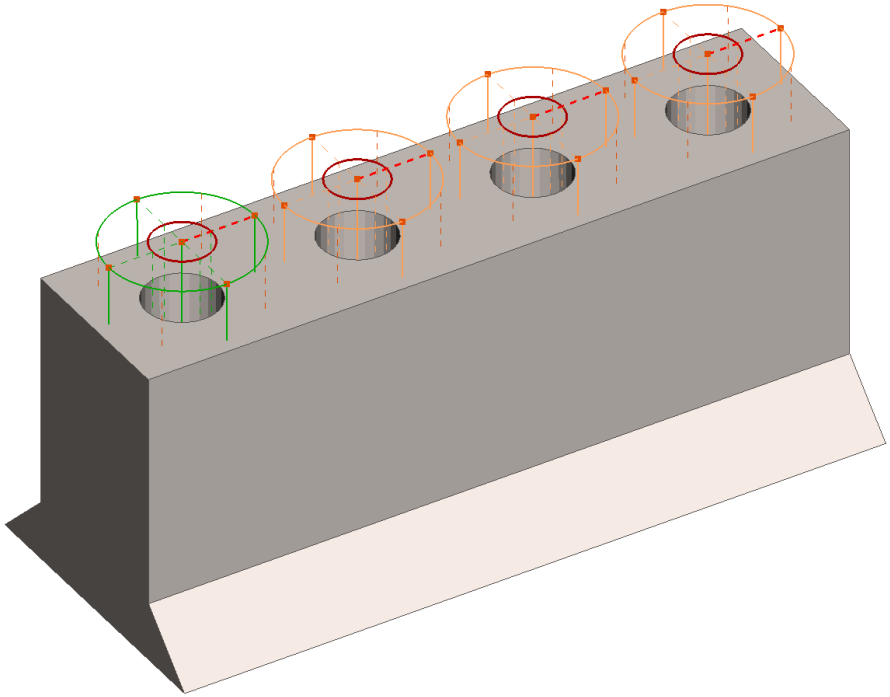
- Move (Translate, Rotate)
- Slide / Extend
- Angle
- Fit (edges, surfaces)
- Radius



# Box Morphing

## How to modify?

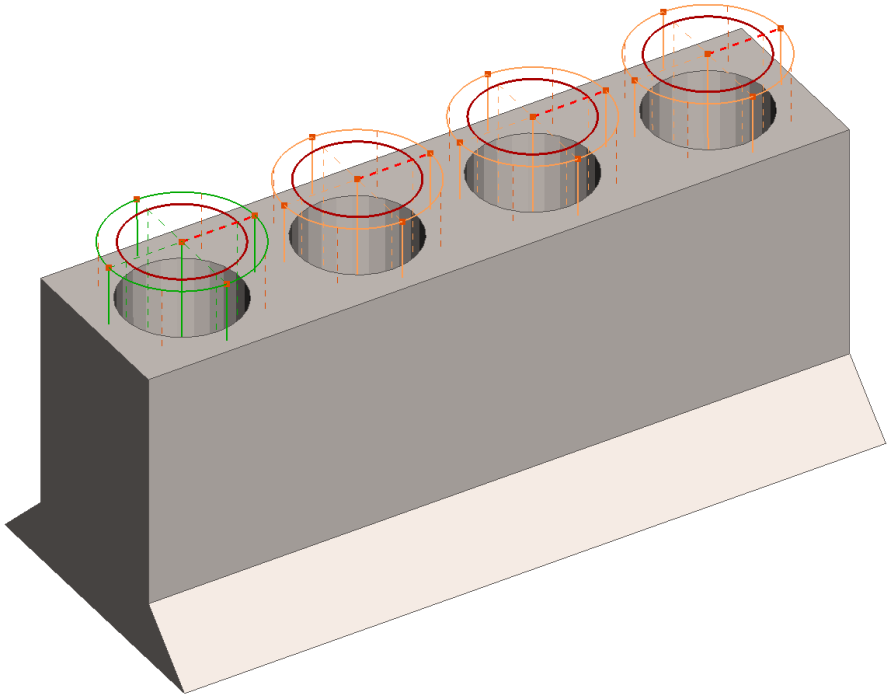
- Move (Translate, Rotate)
- Slide / Extend
- Angle
- Fit (edges, surfaces)
- Radius



# Box Morphing

## How to modify?

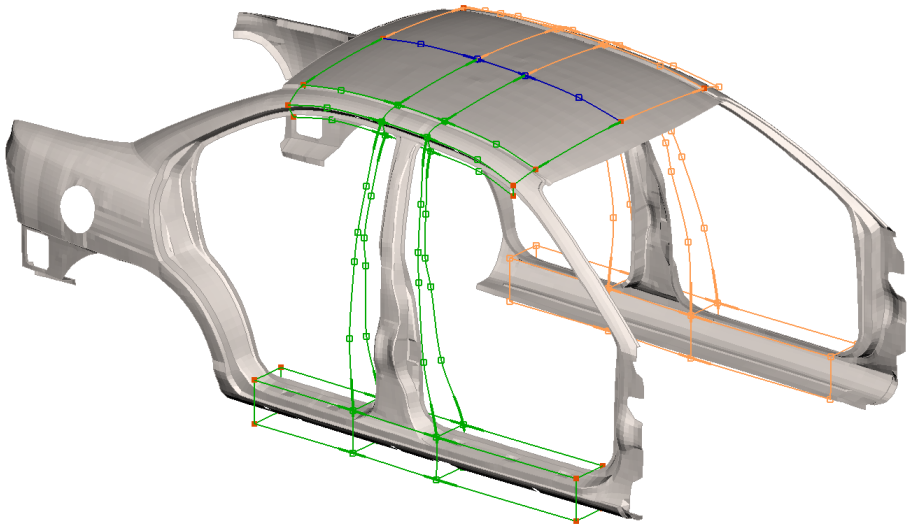
- Move (Translate, Rotate)
- Slide / Extend
- Angle
- Fit (edges, surfaces)
- Radius
- …



# Box Morphing

## Linked Morphing Boxes

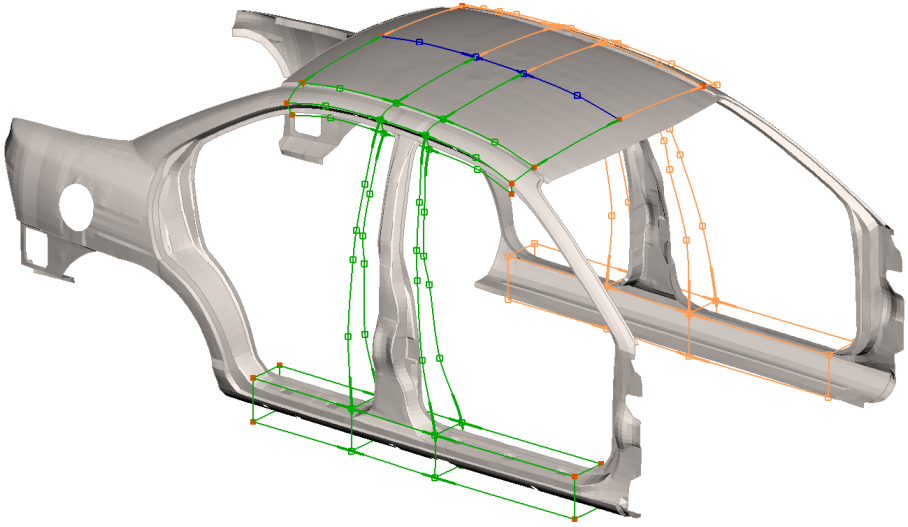
- Utilize model symmetry
- Link according symmetry-/mirror plane

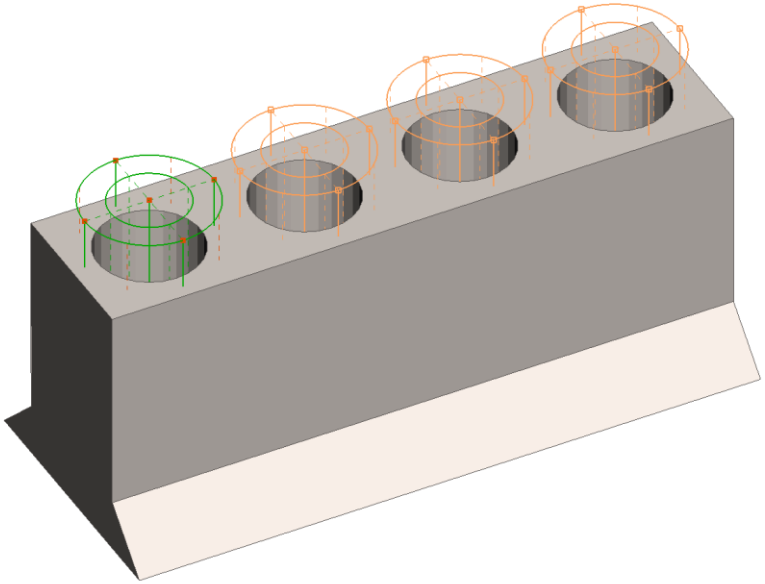


# Box Morphing

## Linked Morphing Boxes

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

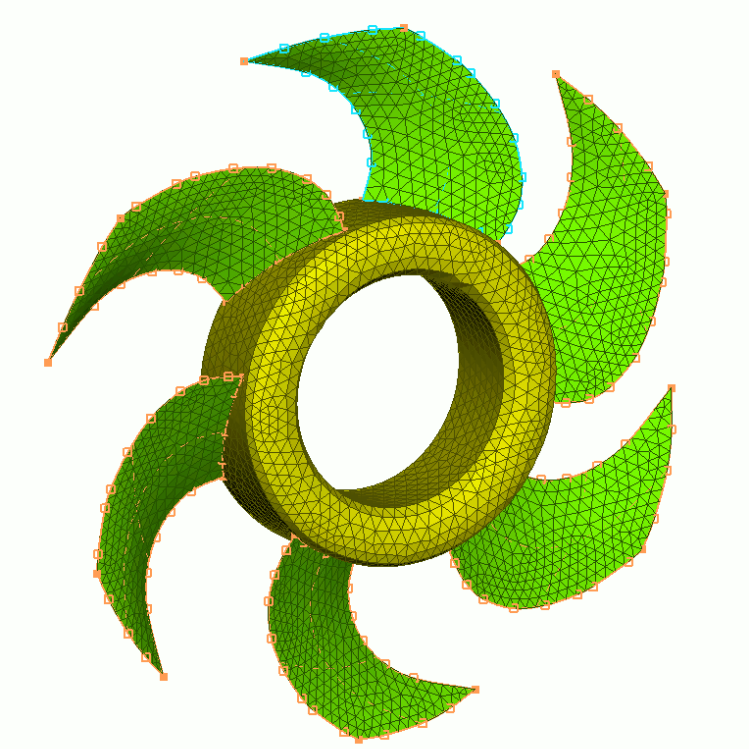




# Box Morphing

## Linked Morphing Boxes

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



# Box Morphing

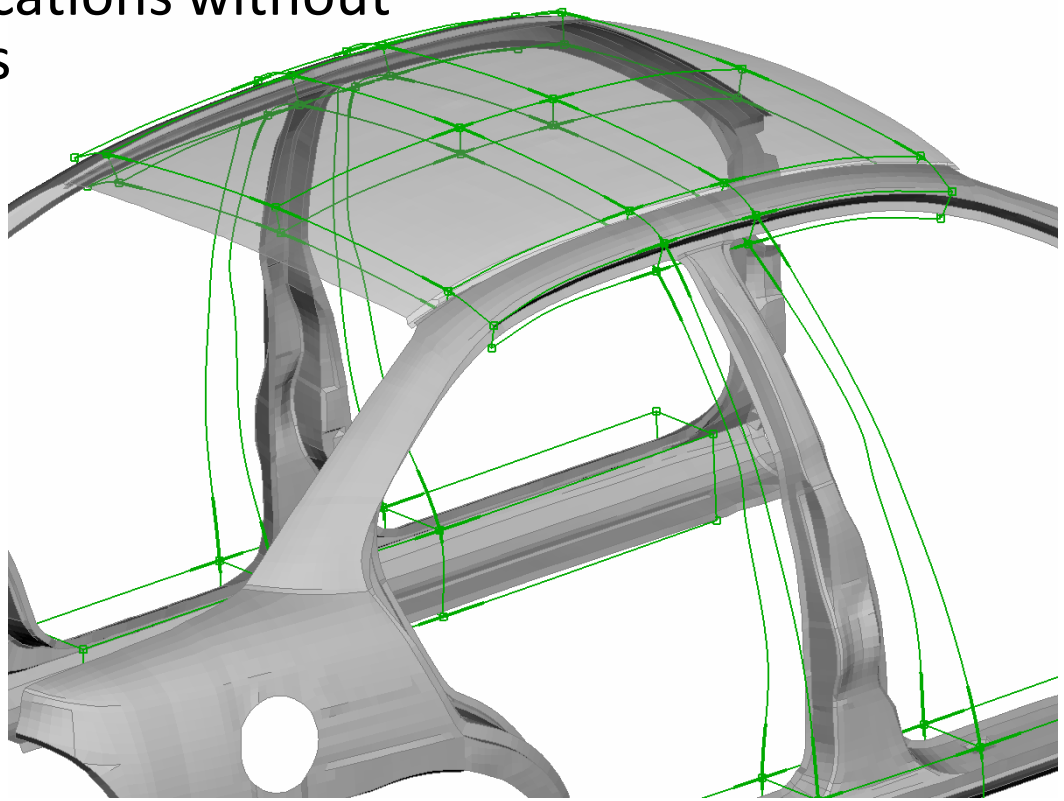
## Box in Box

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

# Box Morphing

## Box in Box

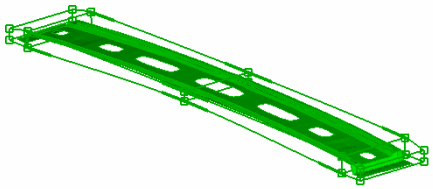
- Separate groups of boxes handle different features
- Global and local modifications without excessive splits of boxes
- Global: B-pillar position



# 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
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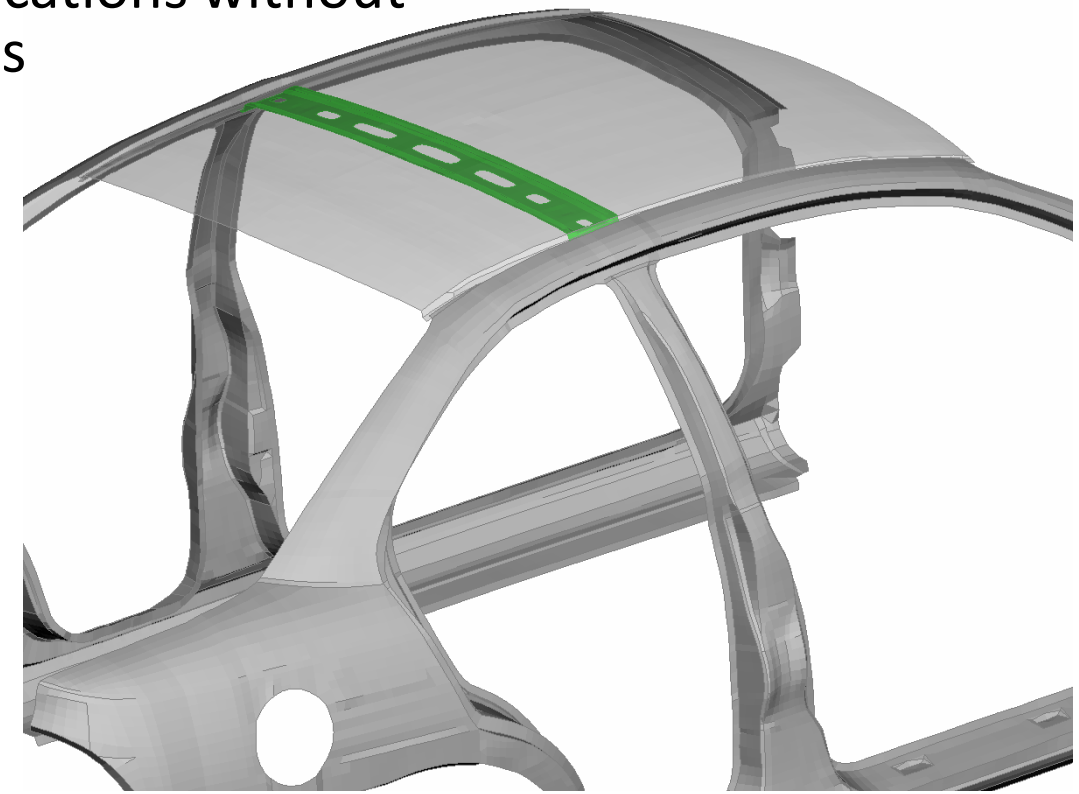
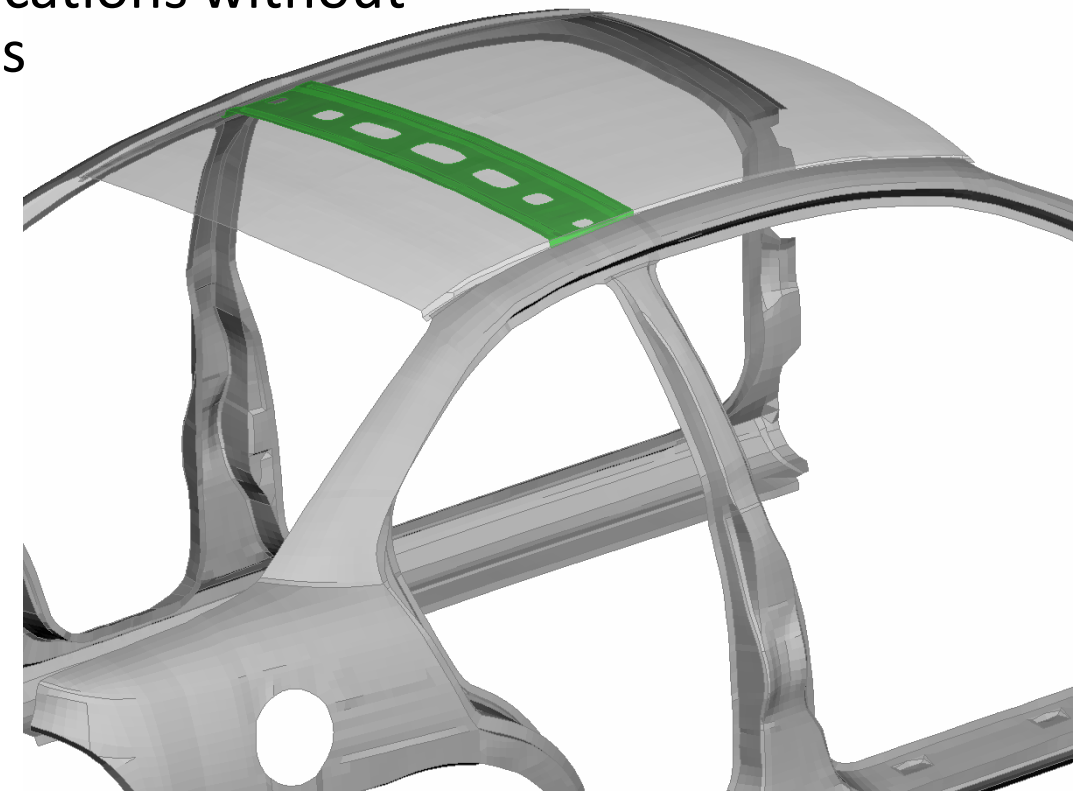


- Global morphing

# Box Morphing

## Box in Box

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

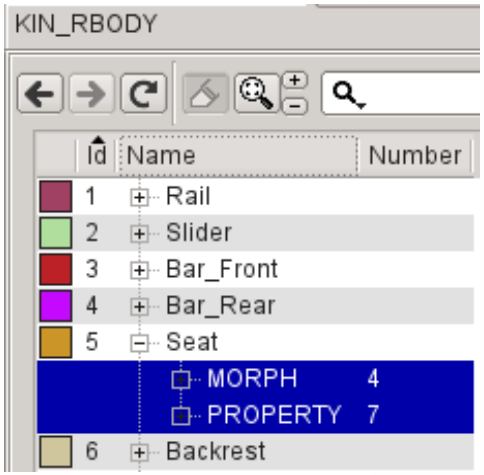


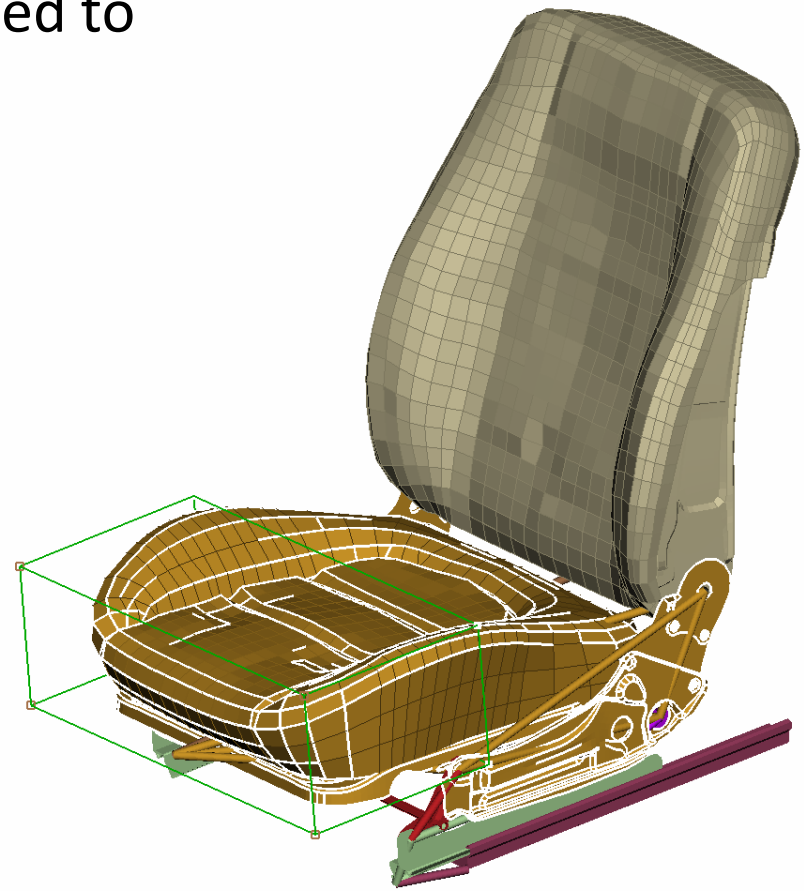
- Global morphing
- Local morphing

# Box Morphing

## Coupled with Kinetics

- Morph Control Points added to Kinetic Rigid Bodies

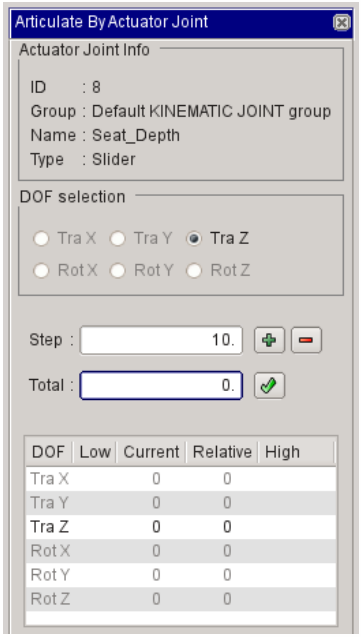


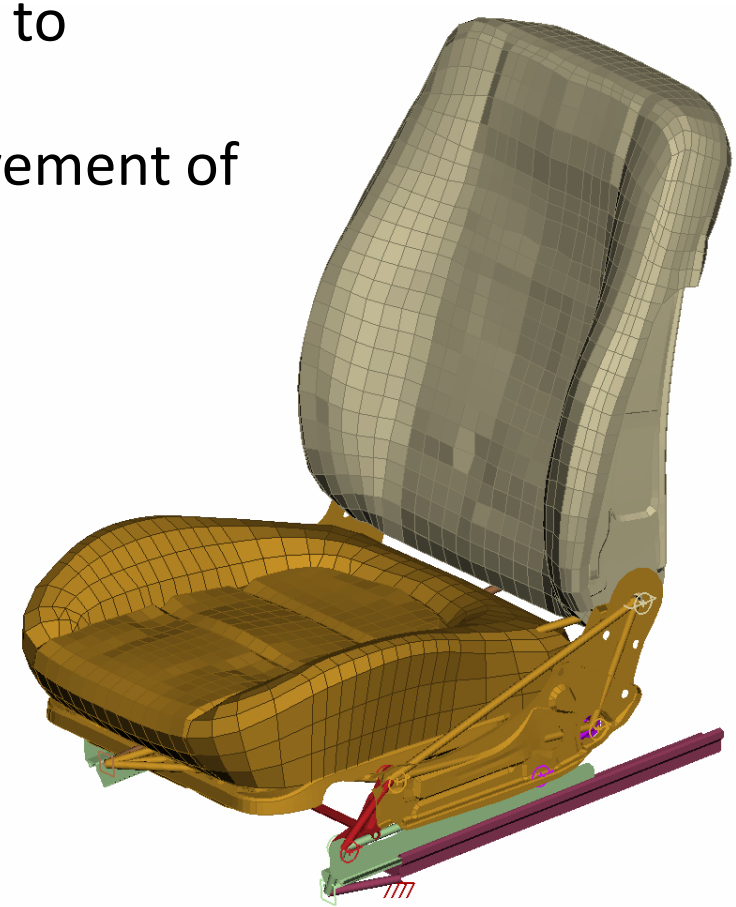



# Box Morphing

## Coupled with Kinetics

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

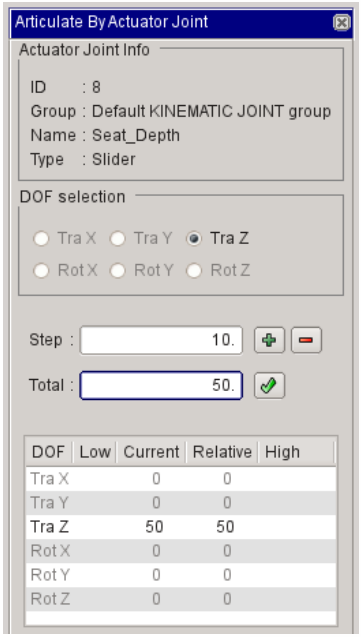


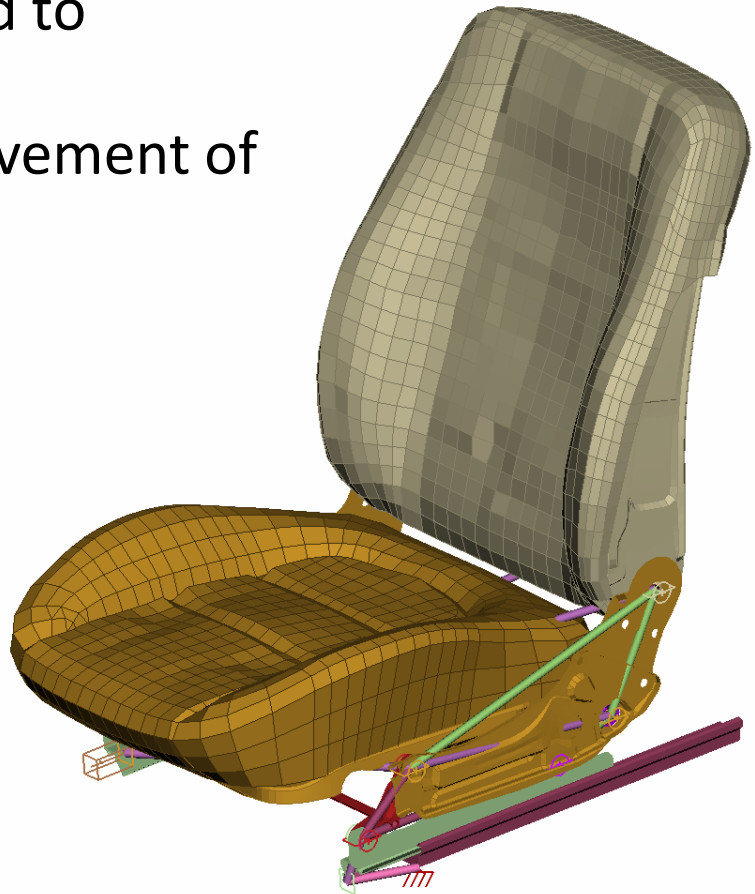



# Box Morphing

## Coupled with Kinetics

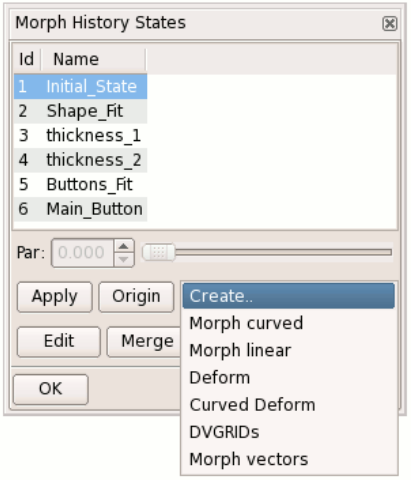
- Morph Control Points added to Kinetic Rigid Bodies
- Morphing controlled by movement of Rigid Bodies



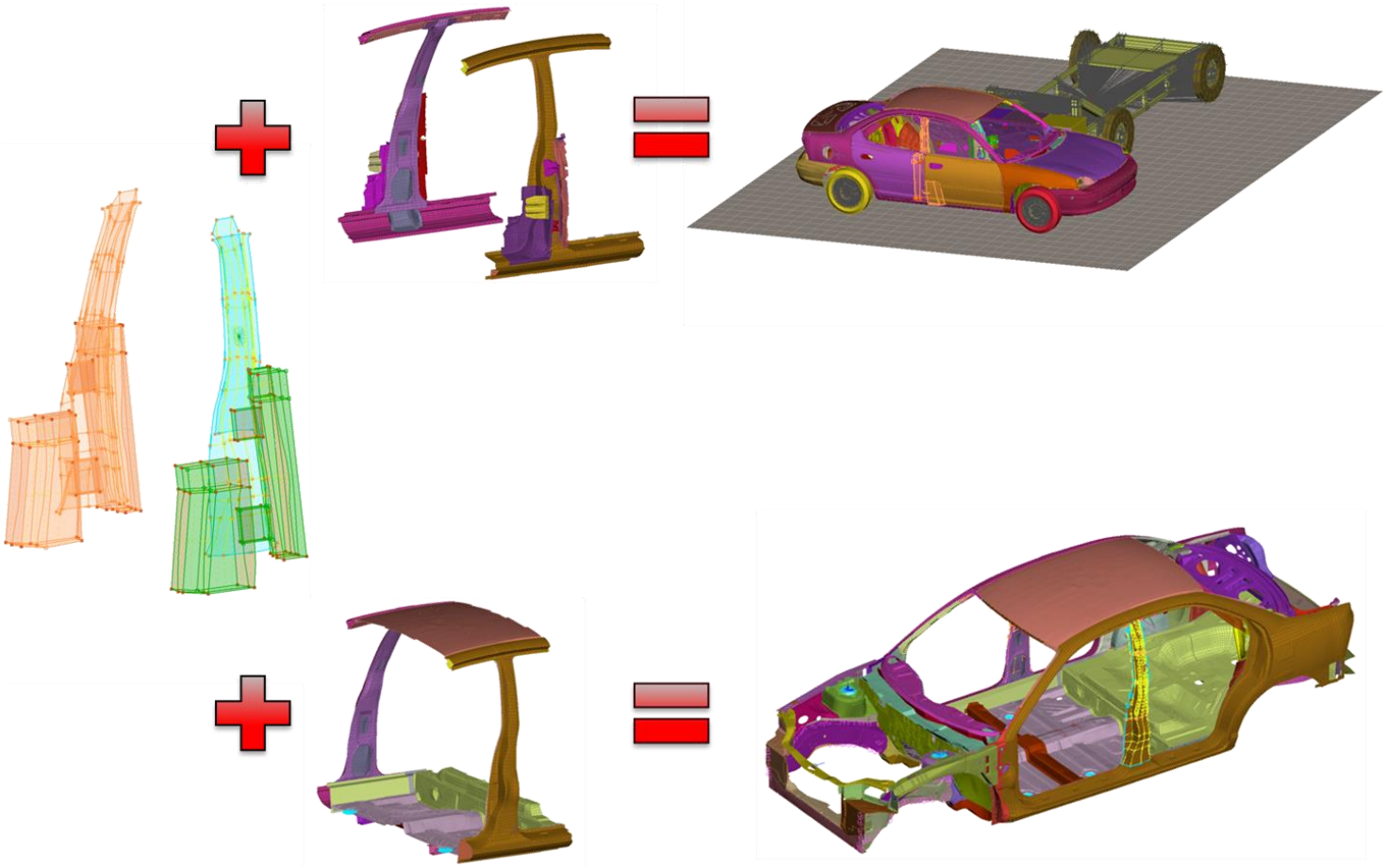
# Box Morphing

## Recording History



# Box Morphing

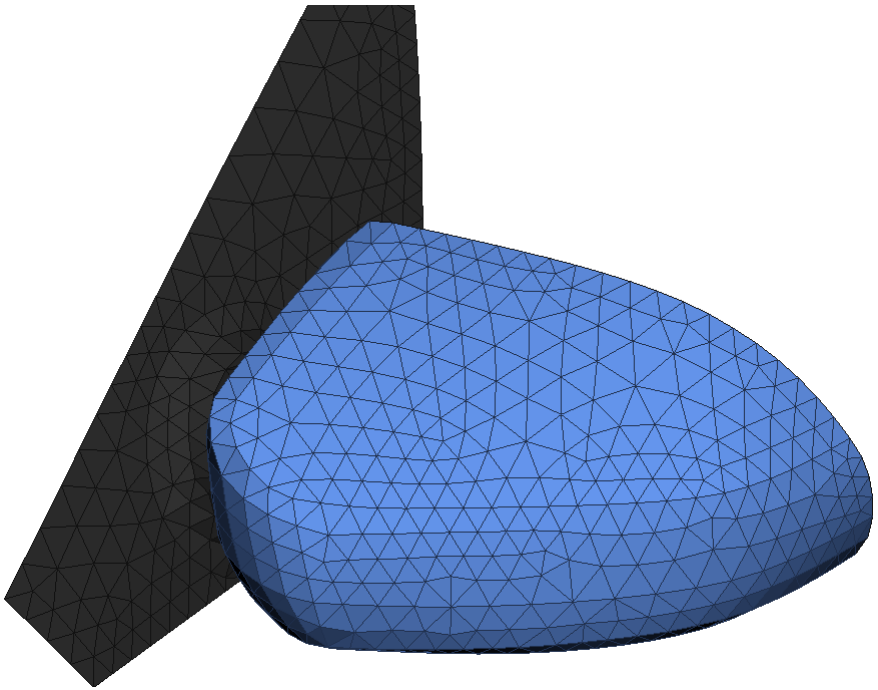
## Re-use of boxes and parameters for multiple similar models



# Direct Morphing

## DFM

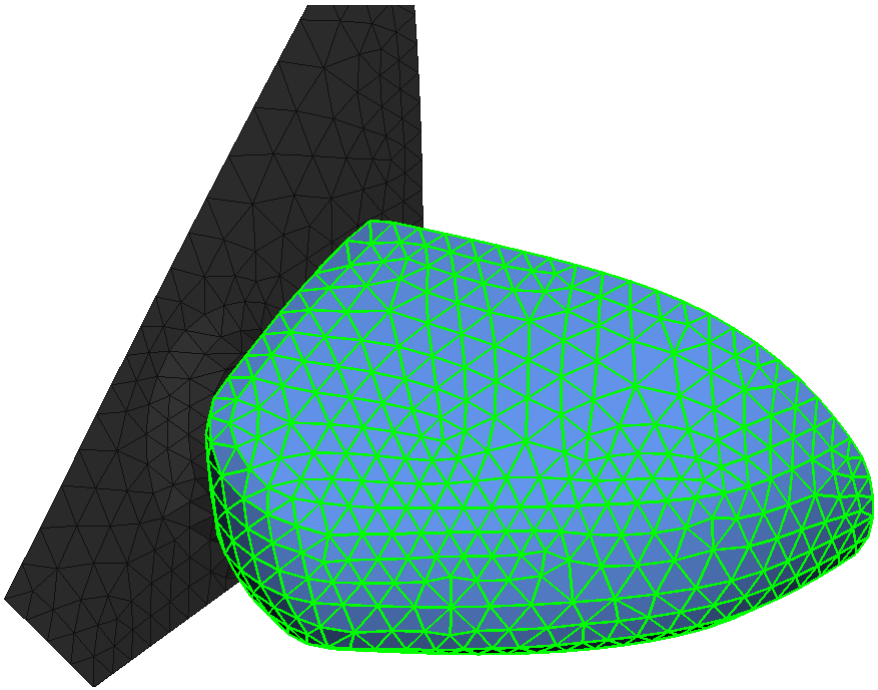
Translate, **rotate** or scale **FE-mesh** or Geometry entities



# Direct Morphing

## DFM

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

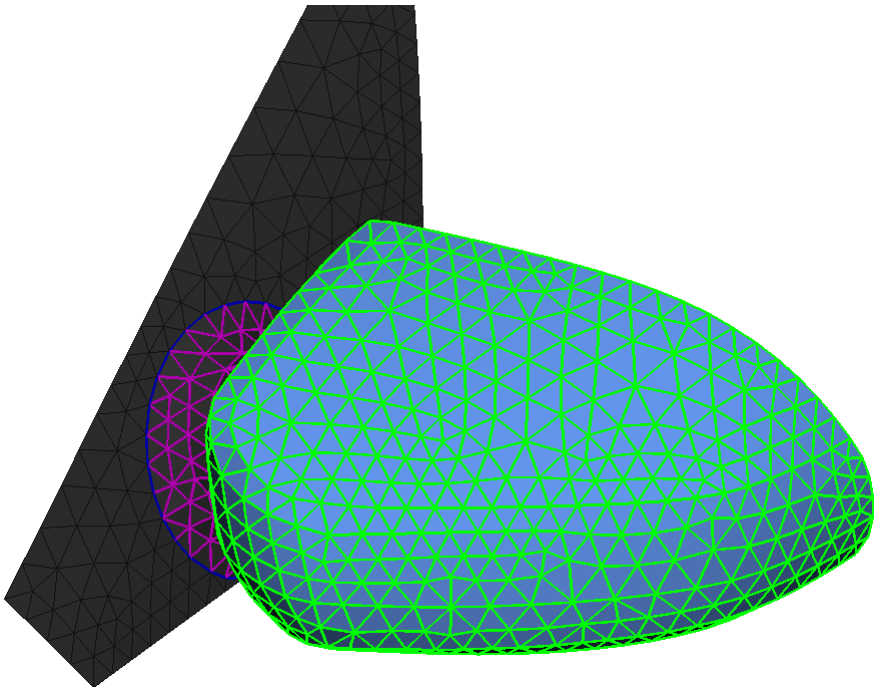


- Control Entities

# Direct Morphing

## DFM

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

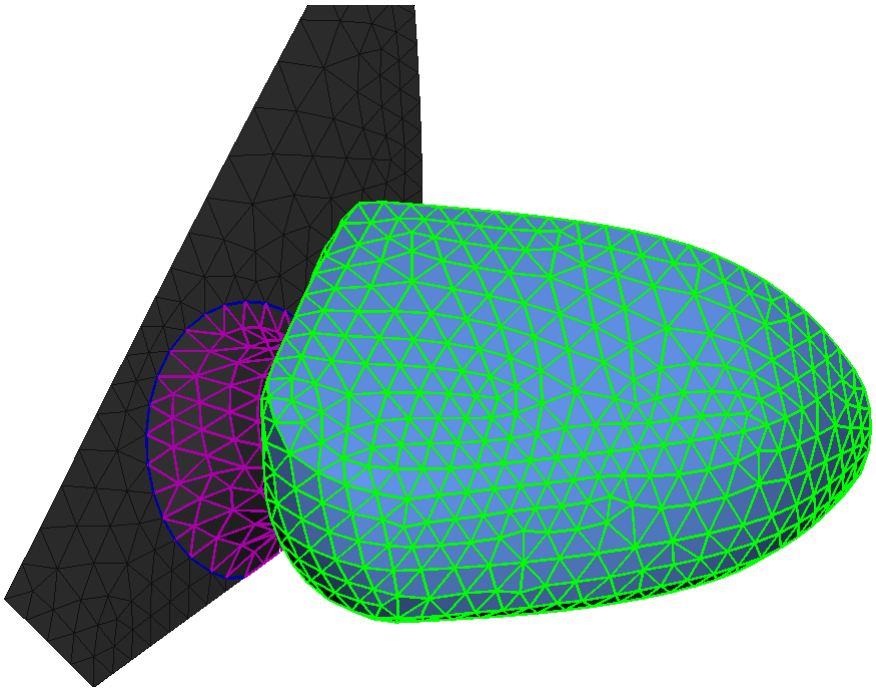


- Control Entities
- Morphed Entities
- Boundary

# Direct Morphing

## DFM

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

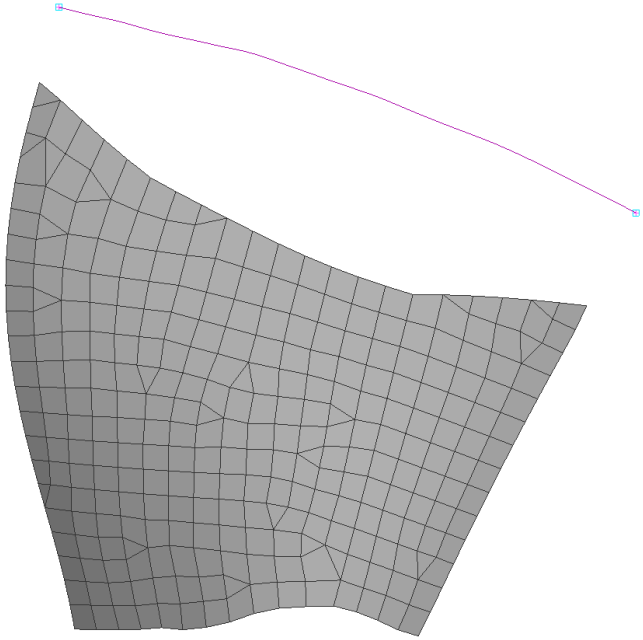


- Control Entities
- Morphed Entities
- Boundary
- Morphing

# Direct Morphing

## DFM

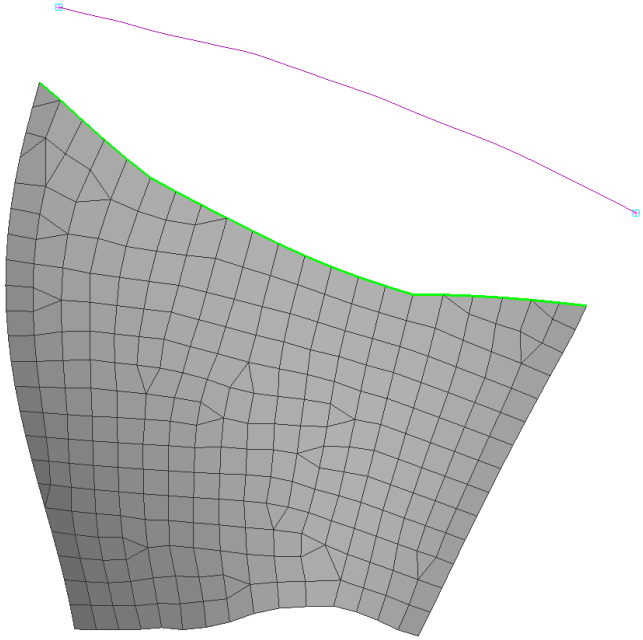
Snap **FE** or geometry edges to **single** or multiple target curves



# Direct Morphing

## DFM

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

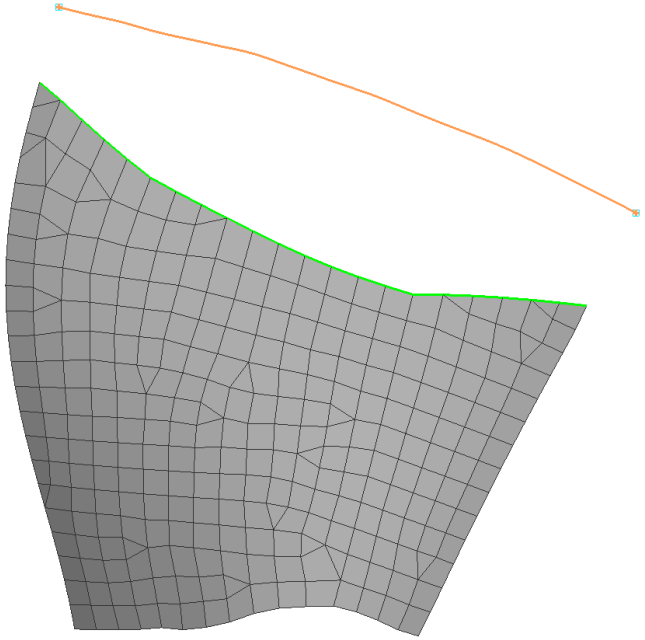


- Origin

# Direct Morphing

## DFM

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

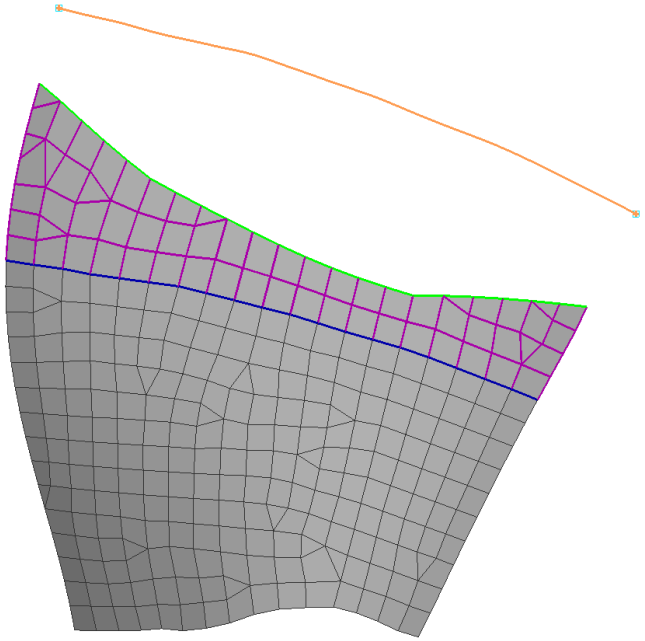


- Origin
- Target

# Direct Morphing

## DFM

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

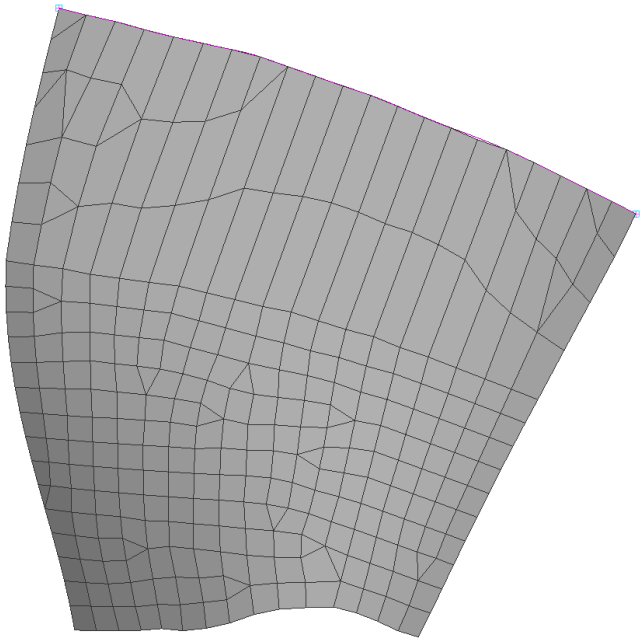


- Origin
- Target
- Morphed Entities
- Boundary

# Direct Morphing

## DFM

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

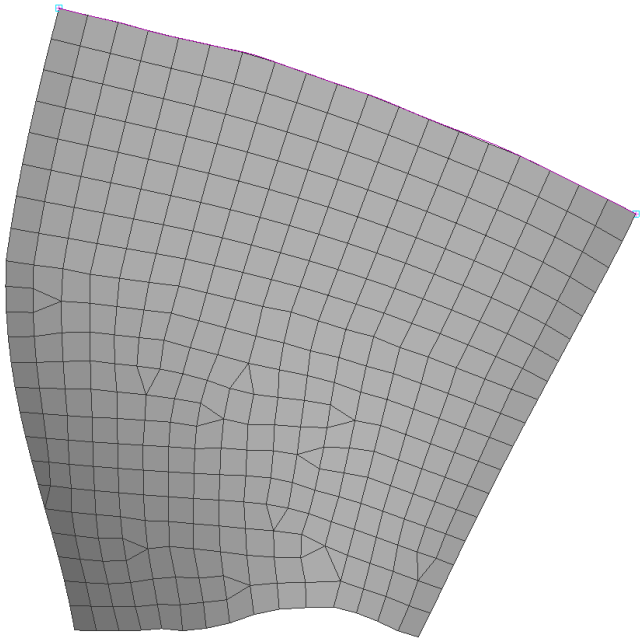


- Origin
- Target
- Morphed Entities
- Boundary
- Morphing

# Direct Morphing

## DFM

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

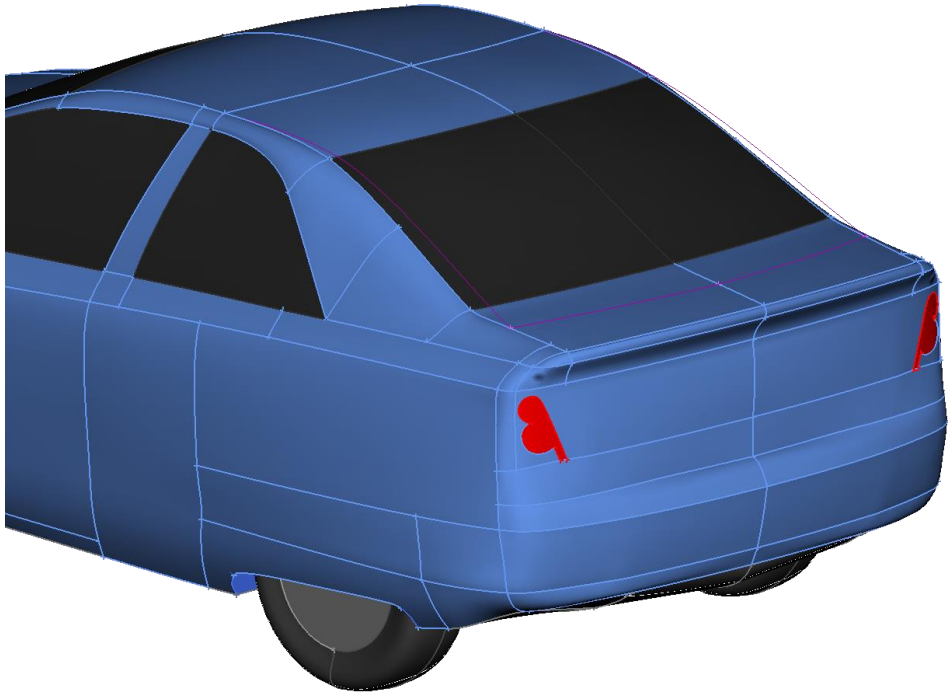


- Origin
- Target
- Morphed Entities
- Boundary
- Morphing
- Reconstruct of morphed area

# Direct Morphing

## DFM

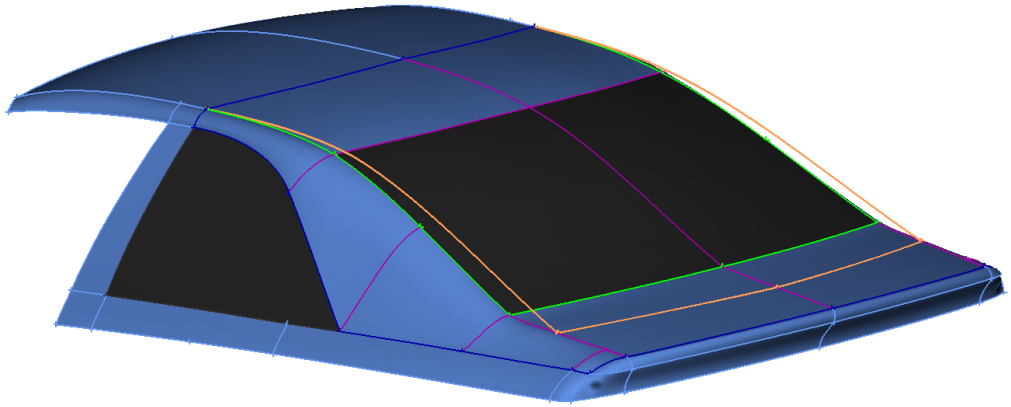
Snap FE or **geometry** edges to single or **multiple** target curves



# Direct Morphing

## DFM

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

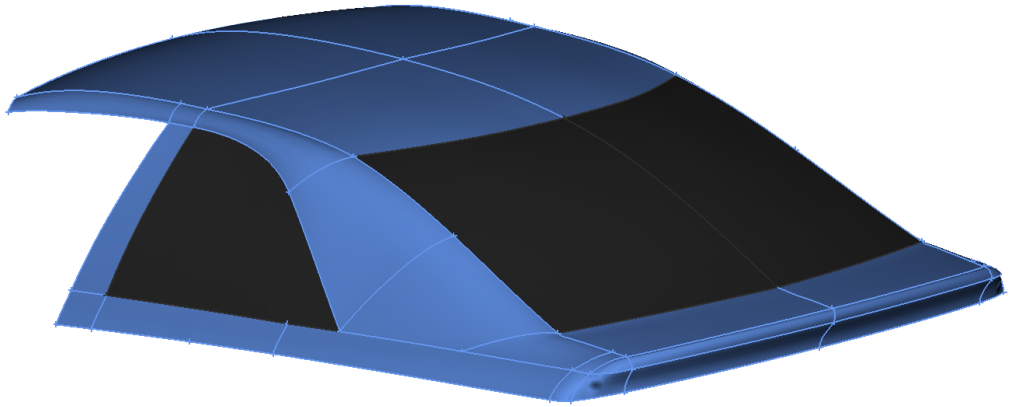


- Origin
- Target
- Morphed Entities
- Boundary

# Direct Morphing

## DFM

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

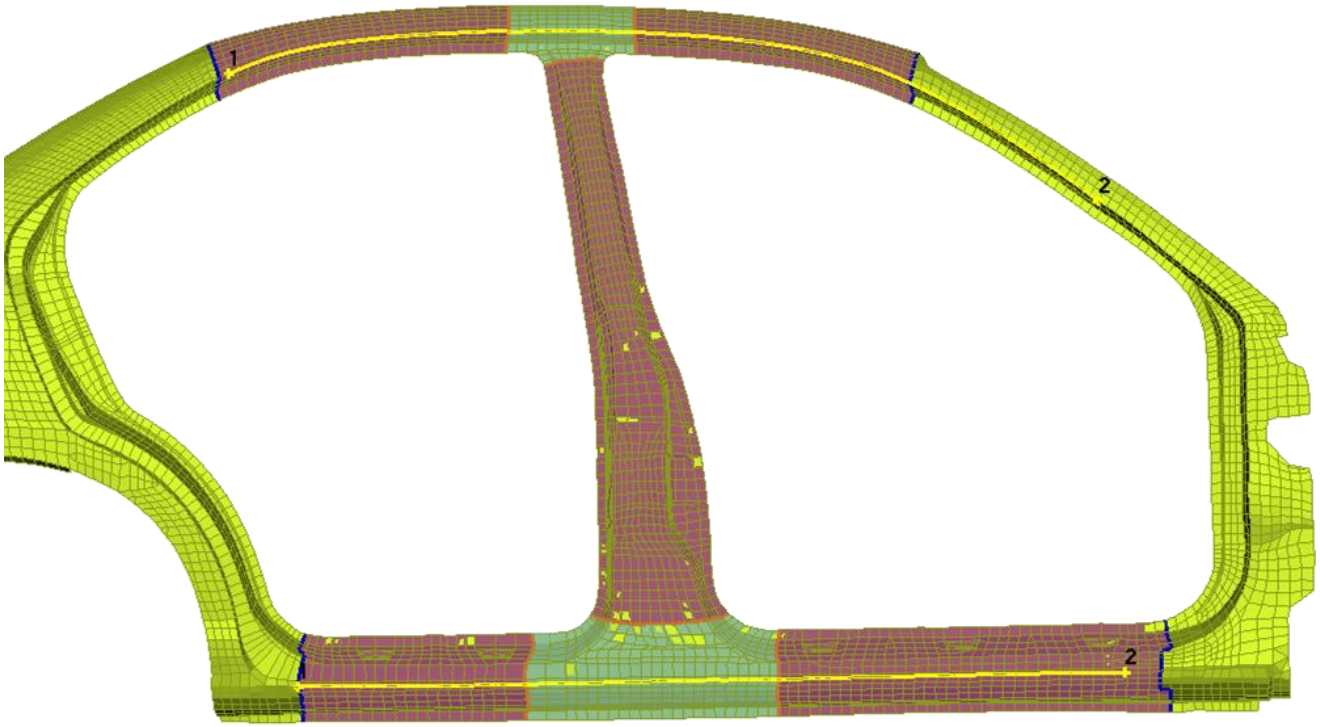


- Origin
- Target
- Morphed Entities
- Boundary
- Morphing

# Direct Morphing

## DFM

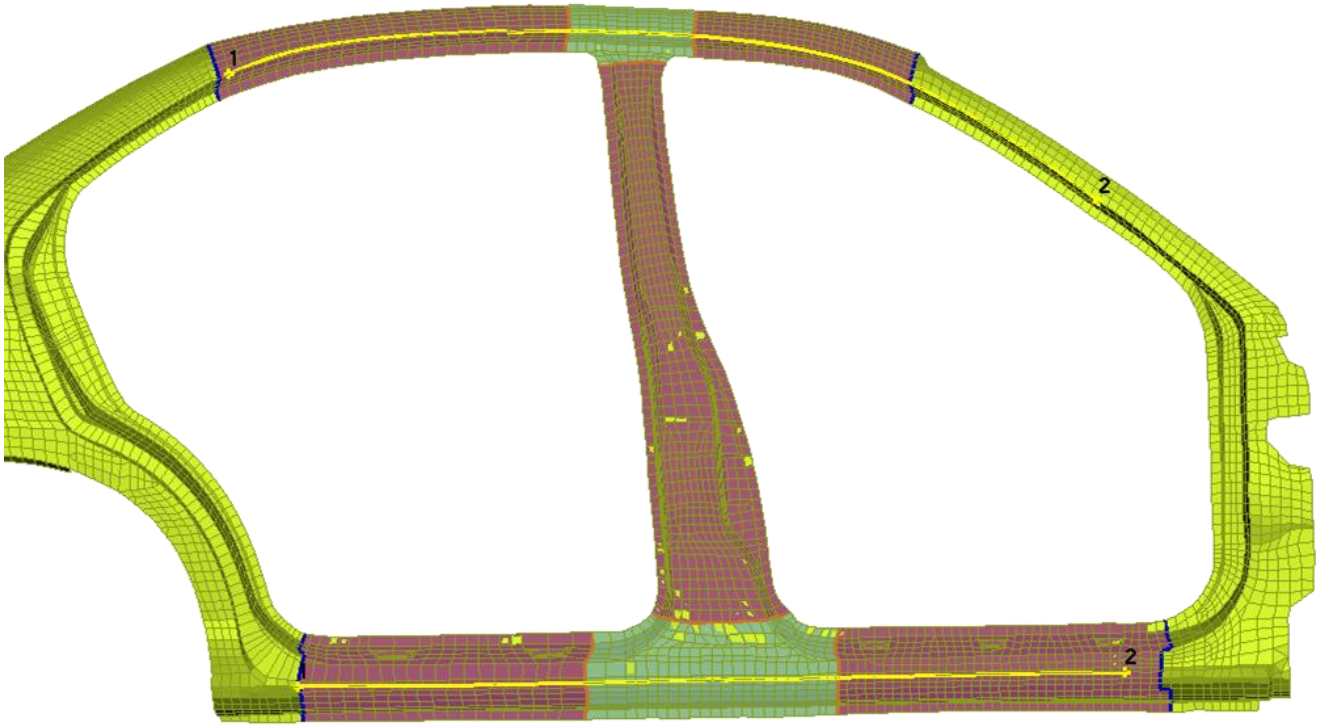
Sweep / Glide along pre-defined curves



# Direct Morphing

## DFM

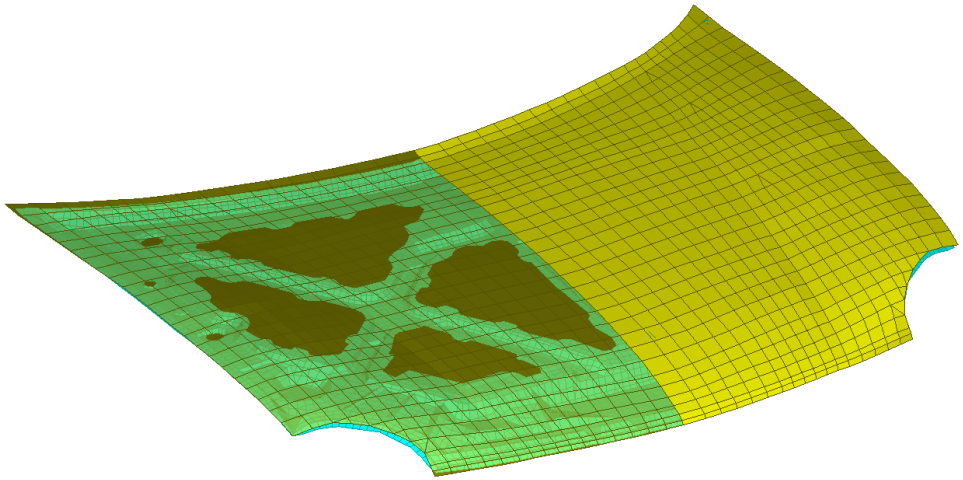
Sweep / Glide along pre-defined curves



# Direct Morphing

## DFM

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

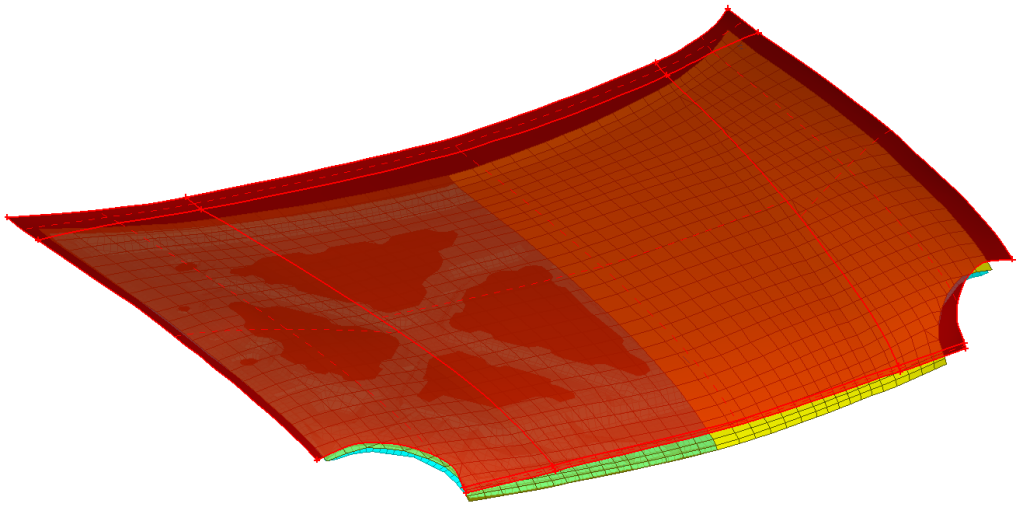


- Initial FE-surface (with additional underlying parts)

# Direct Morphing

## DFM

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

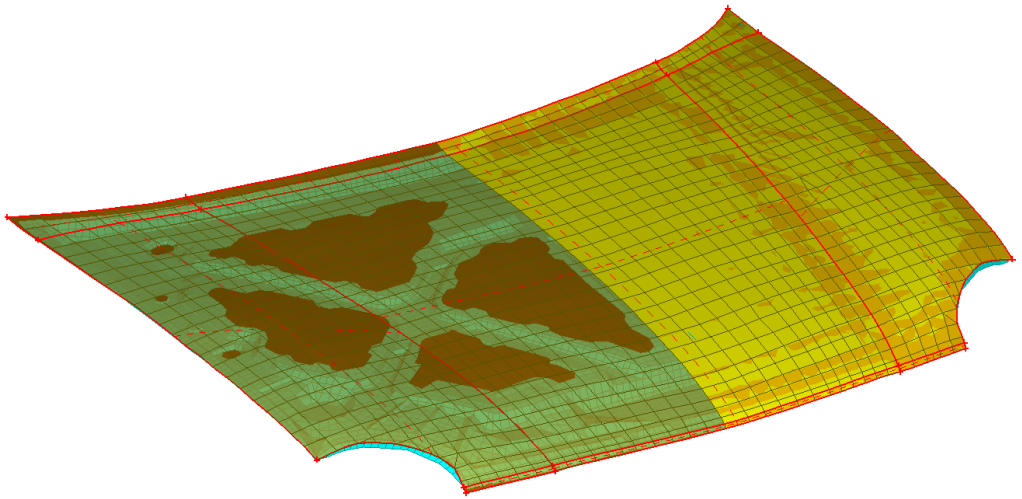


- Initial FE-surface (with additional underlying parts)
- Target CAD-surface

# Direct Morphing

## DFM

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

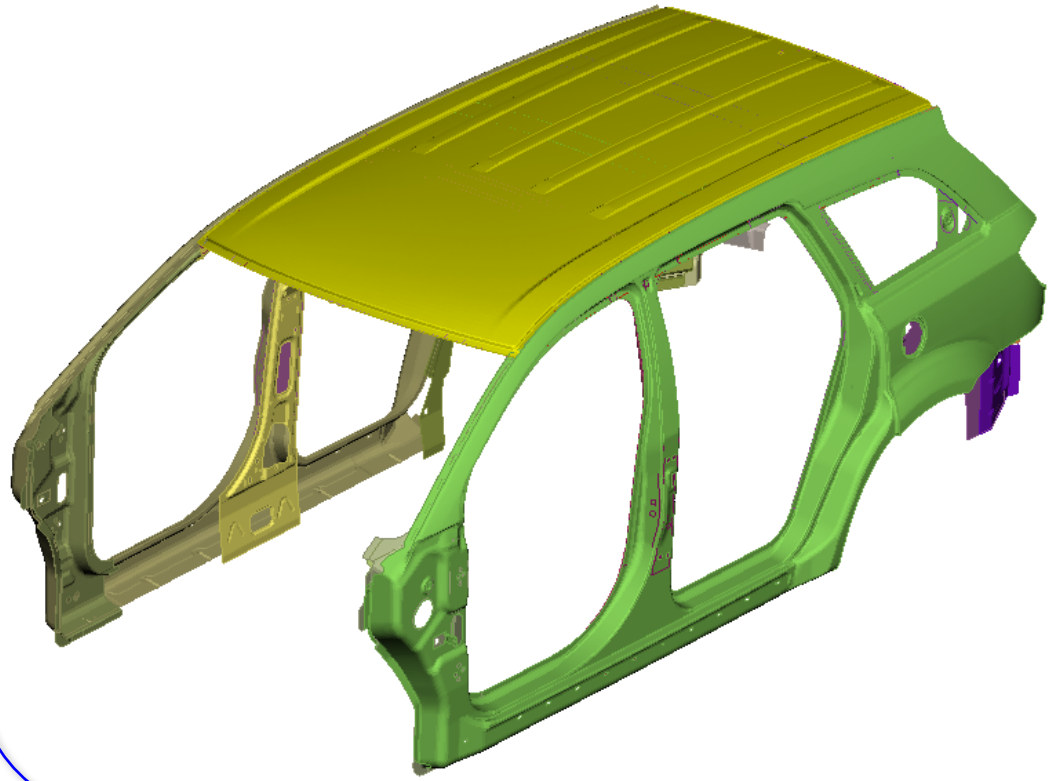


- Initial FE-surface (with additional underlying parts)
- Target CAD-surface
- Morphing

# Direct Morphing

## DFM

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

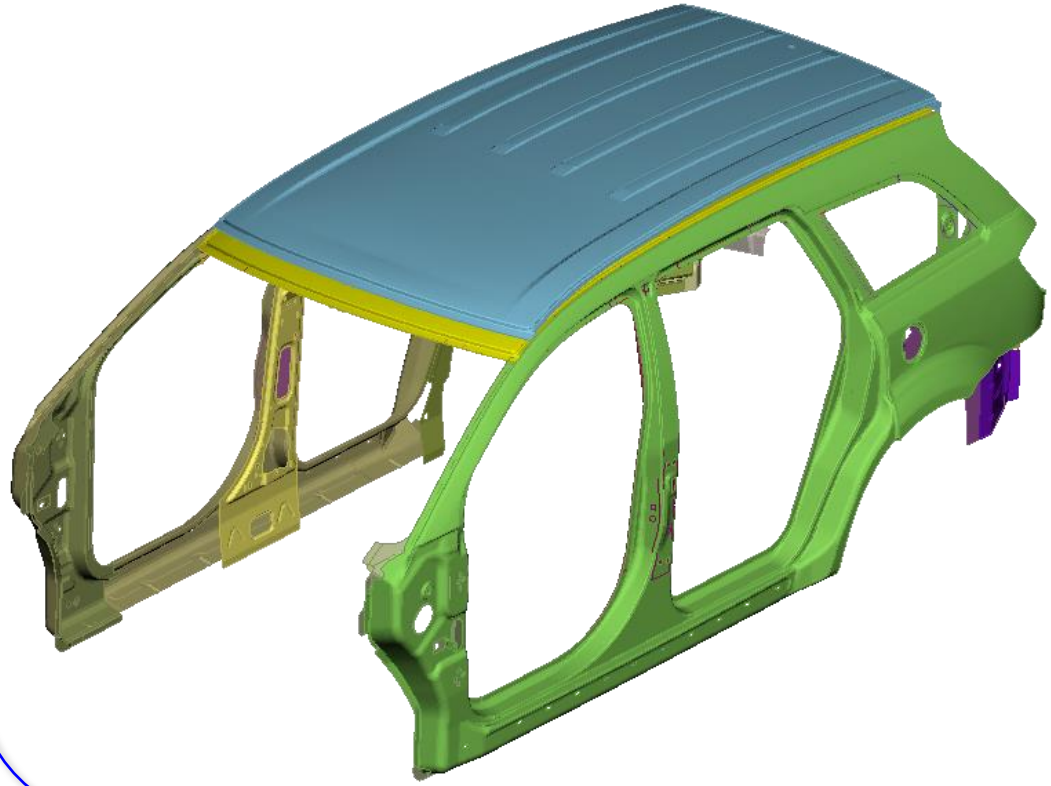


- Initial FE-surface

# Direct Morphing

## DFM

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

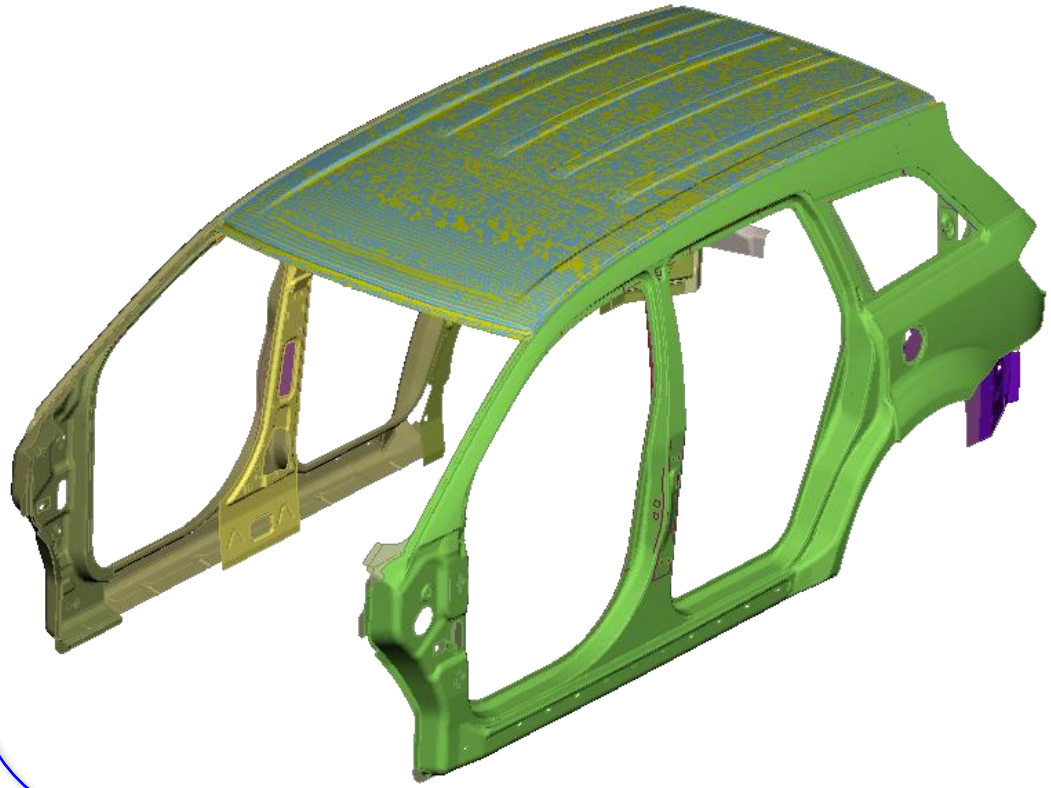


- Initial FE-surface
- Target FE-surface

# Direct Morphing

## DFM

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

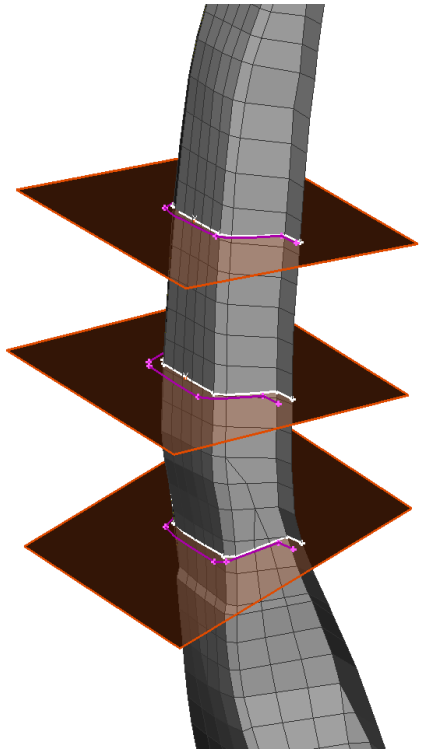


- Initial FE-surface
- Target FE-surface
- Morphing

# Direct Morphing

## Cross Sections

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

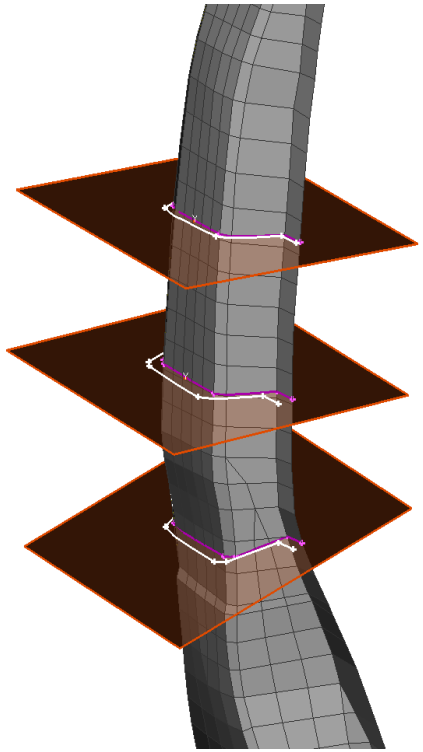


- Original cross section

# Direct Morphing

## Cross Sections

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

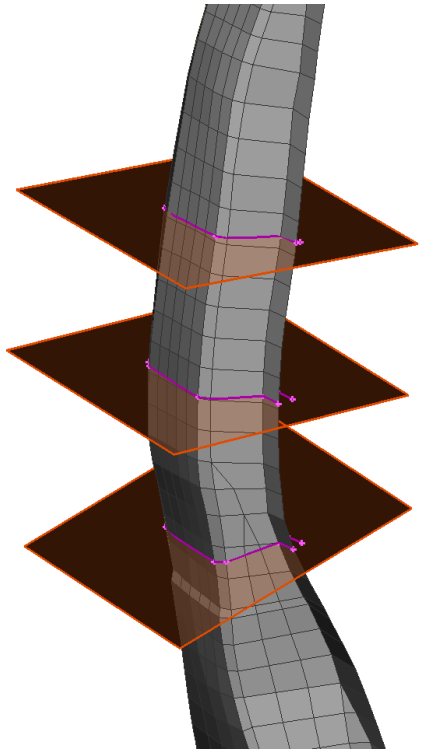


- Original cross section
- Target cross section

# Direct Morphing

## Cross Sections

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

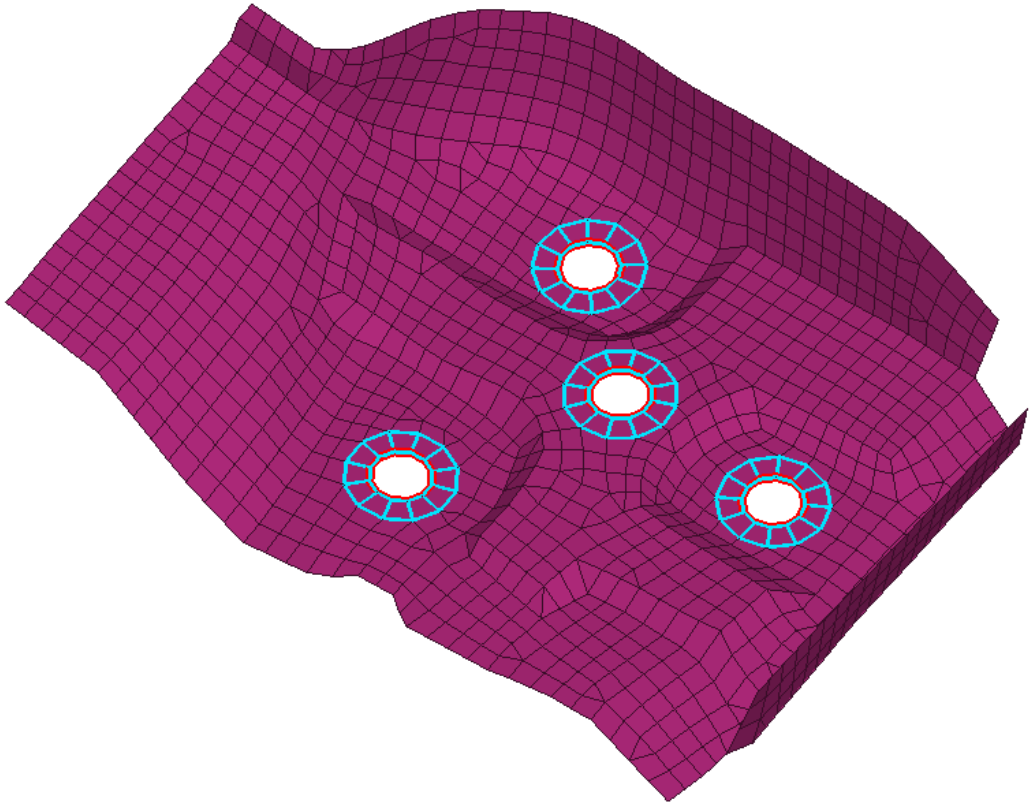


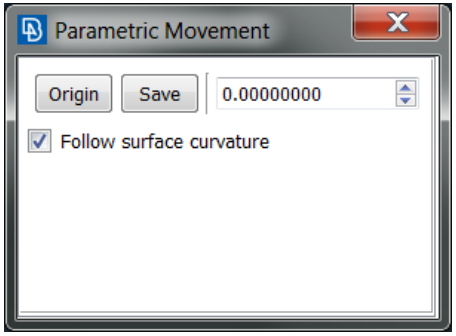
- Original cross section
- Target cross section
- Morphing

# Direct Morphing

## 2D & 3D Holes

Manipulate diameter of **2D Holes**

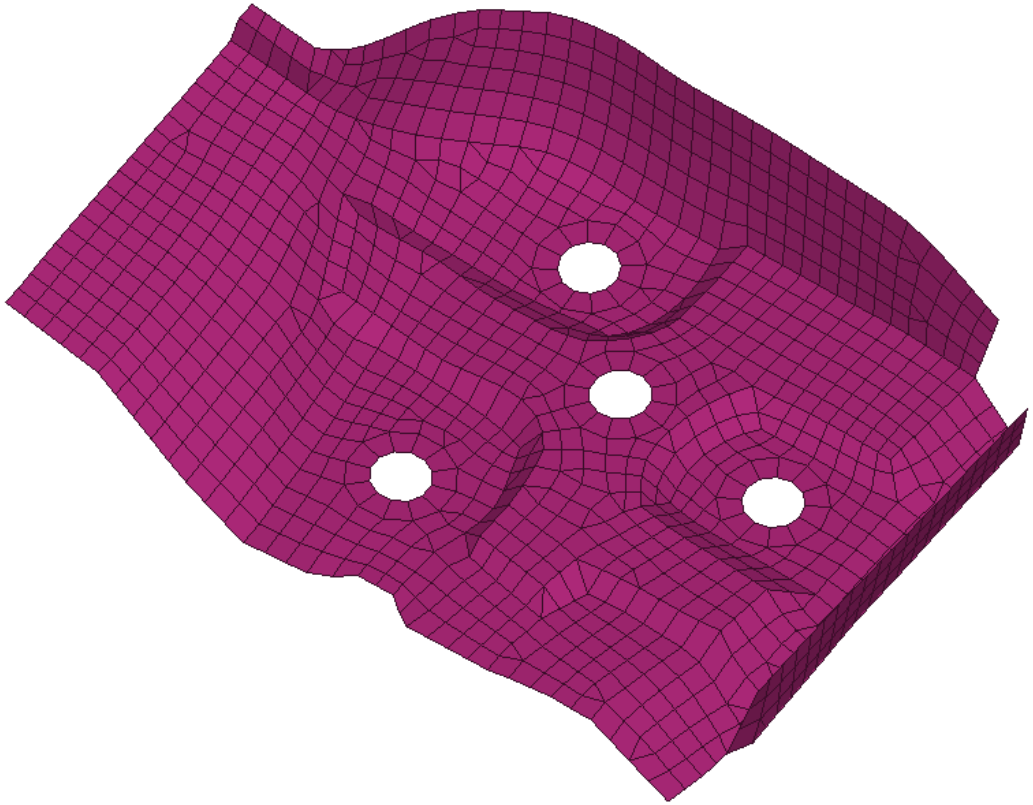


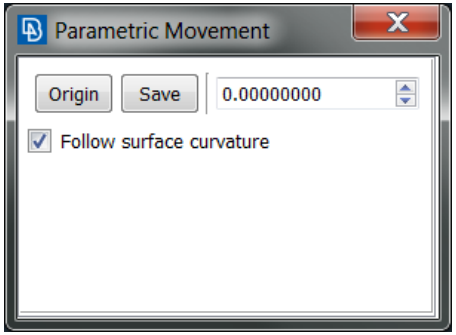


# Direct Morphing

## 2D & 3D Holes

Manipulate diameter of **2D Holes**

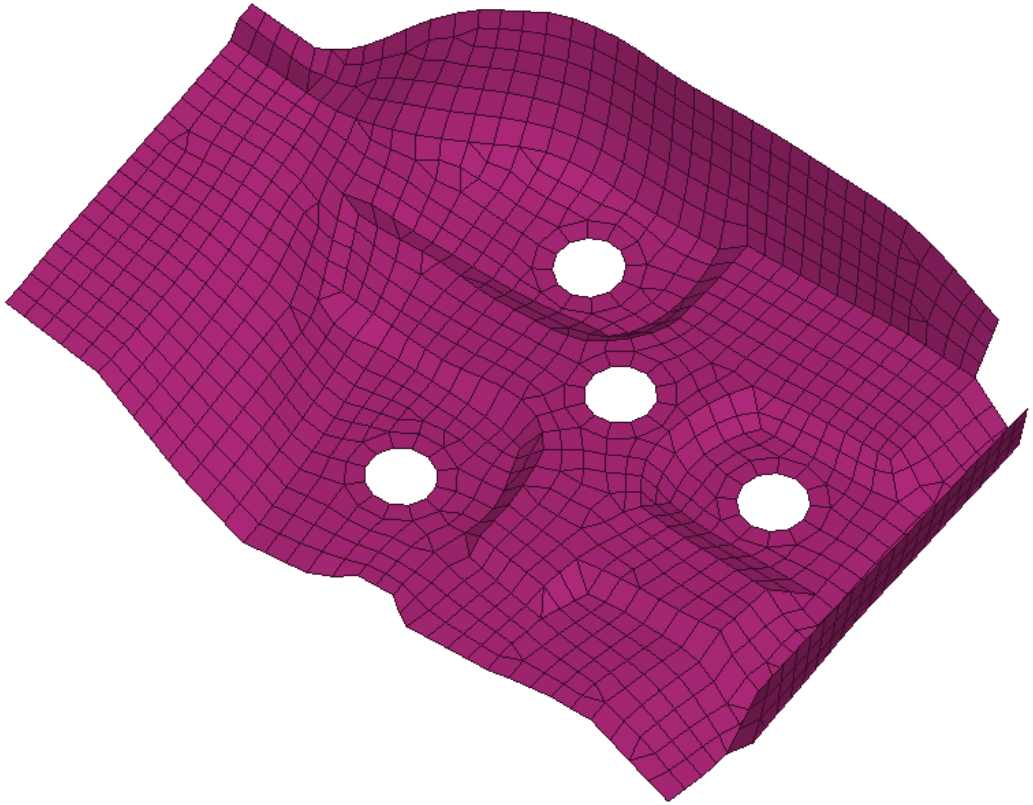


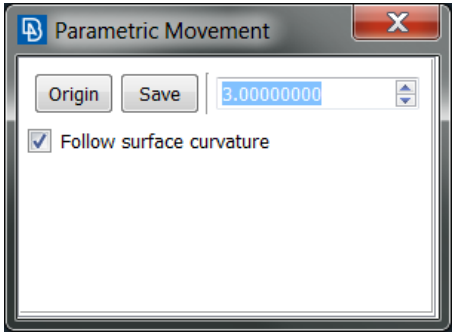


# Direct Morphing

## 2D & 3D Holes

Manipulate diameter of **2D Holes**

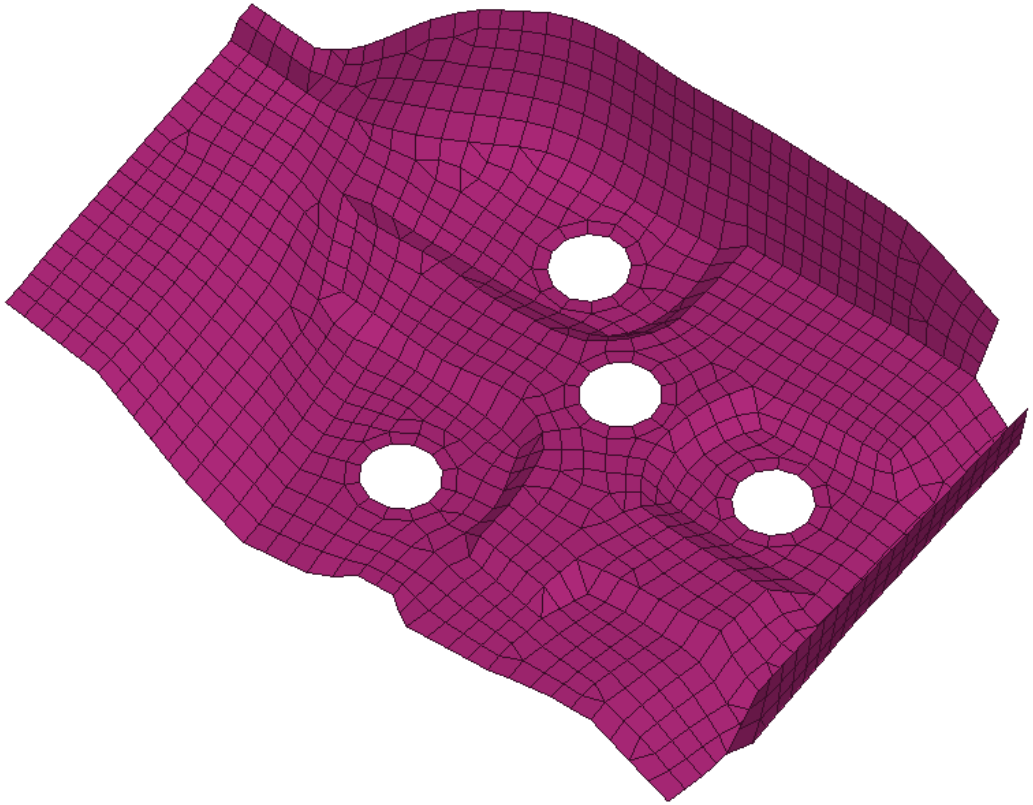


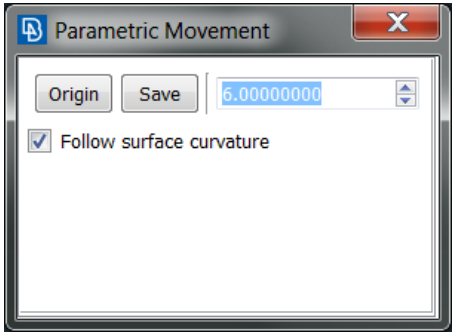


# Direct Morphing

## 2D & 3D Holes

Manipulate diameter of **2D Holes**

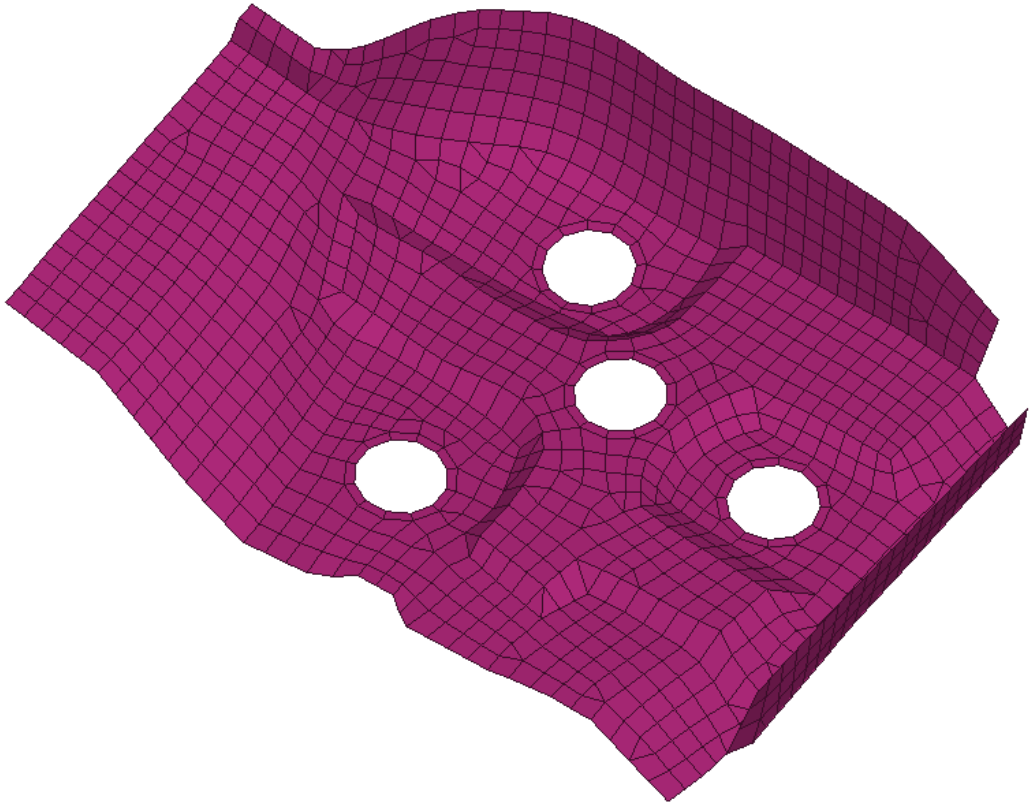


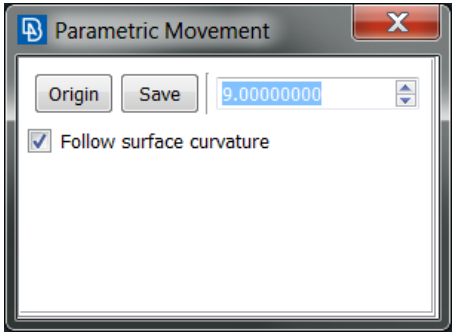


# Direct Morphing

## 2D & 3D Holes

Manipulate diameter of **2D Holes**

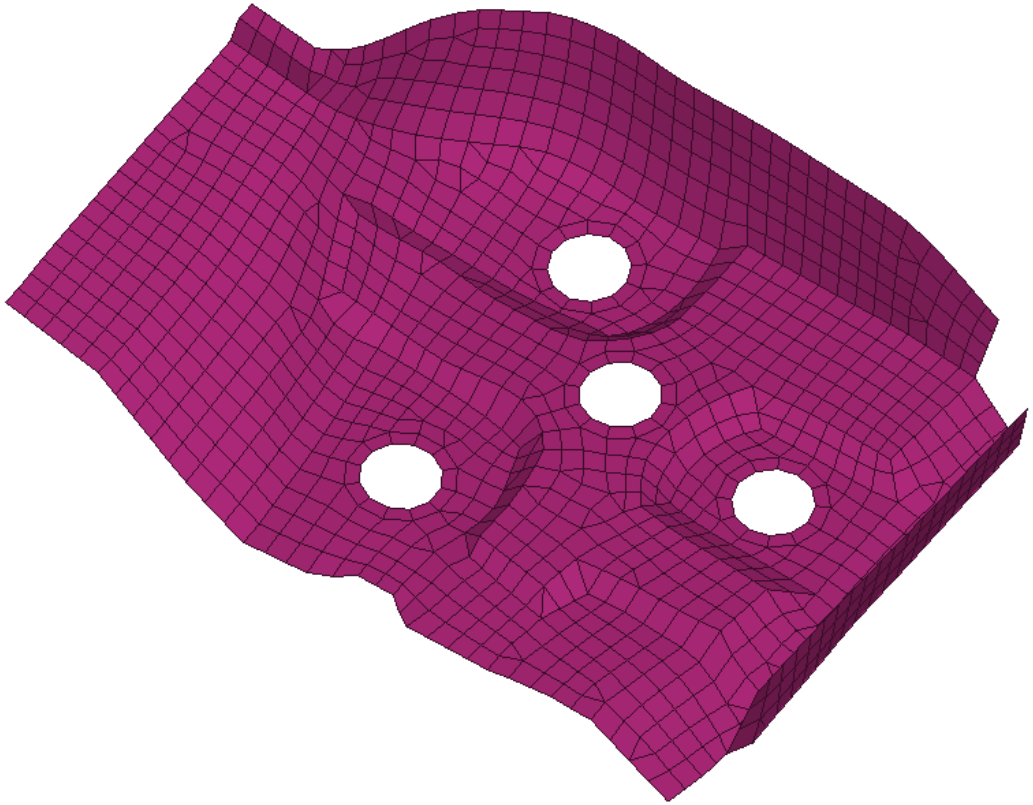


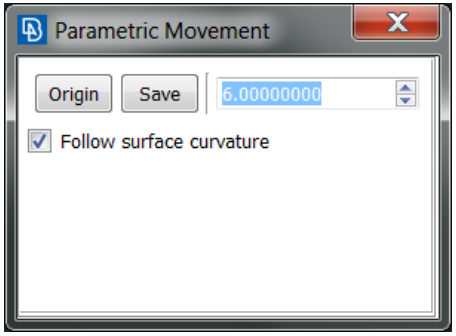


# Direct Morphing

## 2D & 3D Holes

Manipulate diameter of **2D Holes**

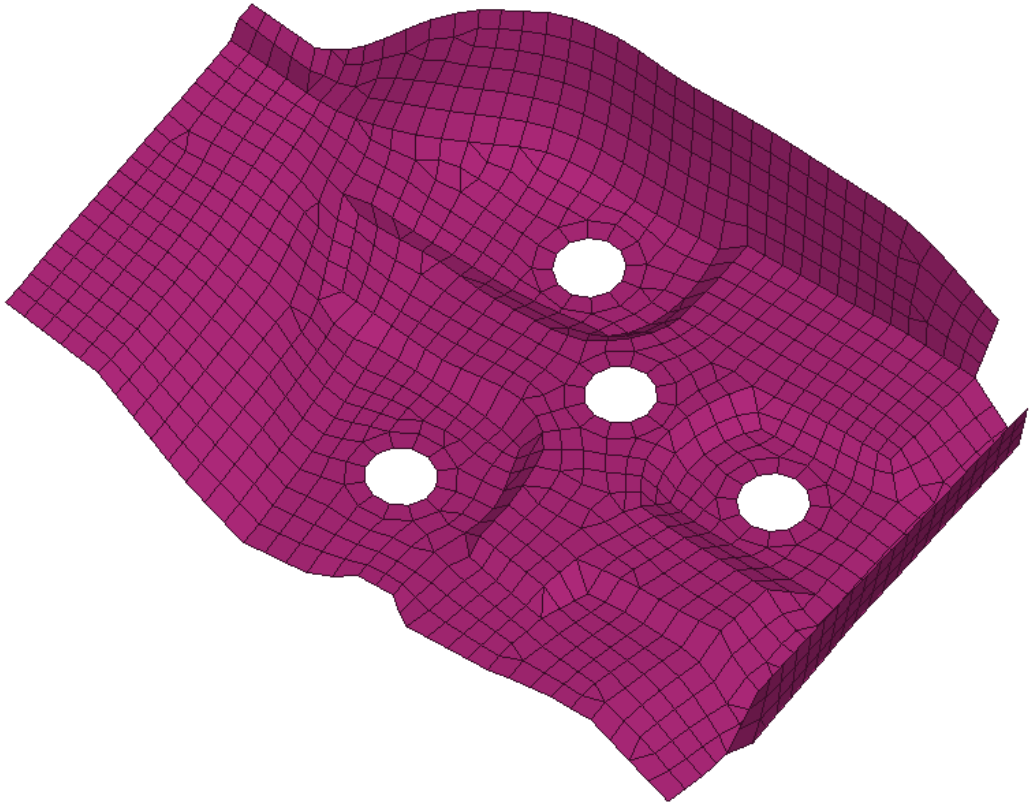


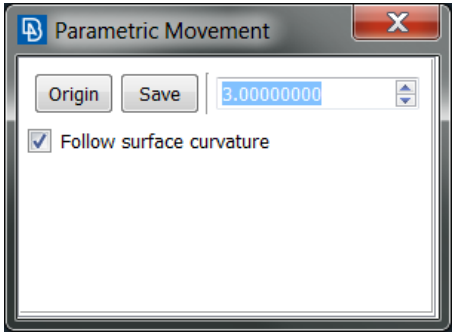


# Direct Morphing

## 2D & 3D Holes

Manipulate diameter of **2D Holes**

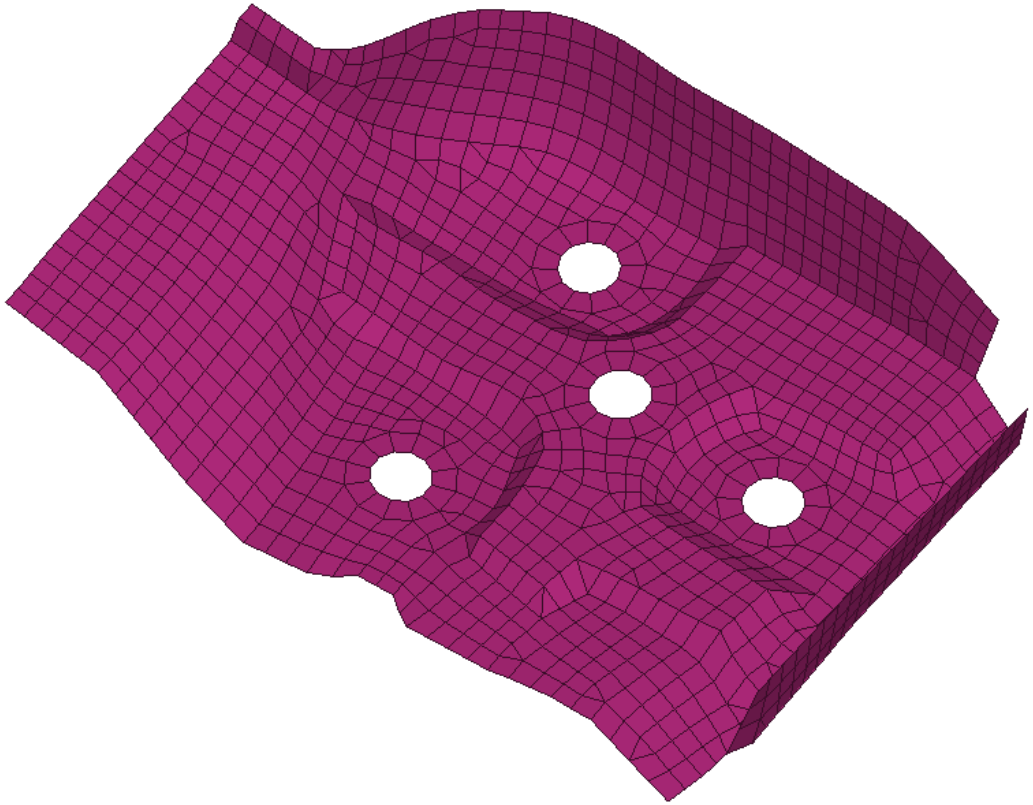


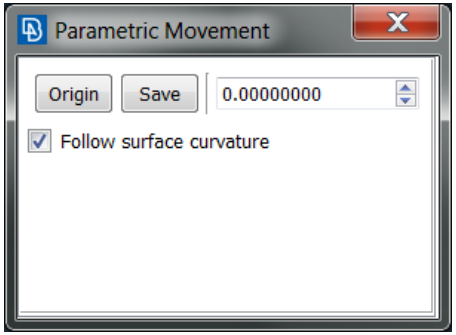


# Direct Morphing

## 2D & 3D Holes

Manipulate diameter of **2D Holes**

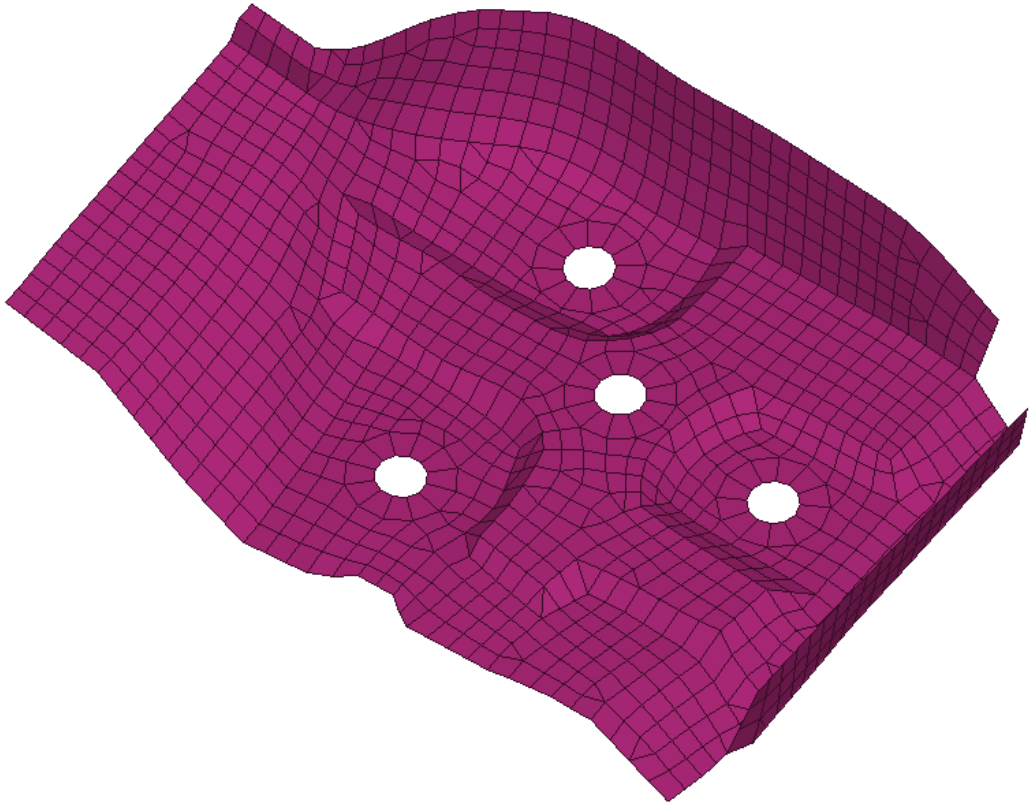


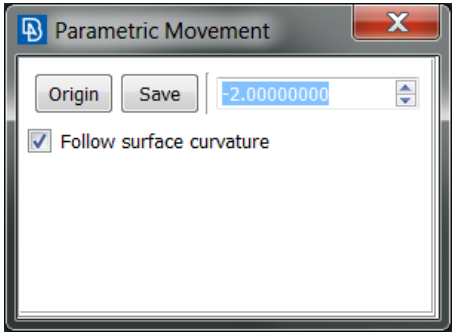


# Direct Morphing

## 2D & 3D Holes

Manipulate diameter of **2D Holes**

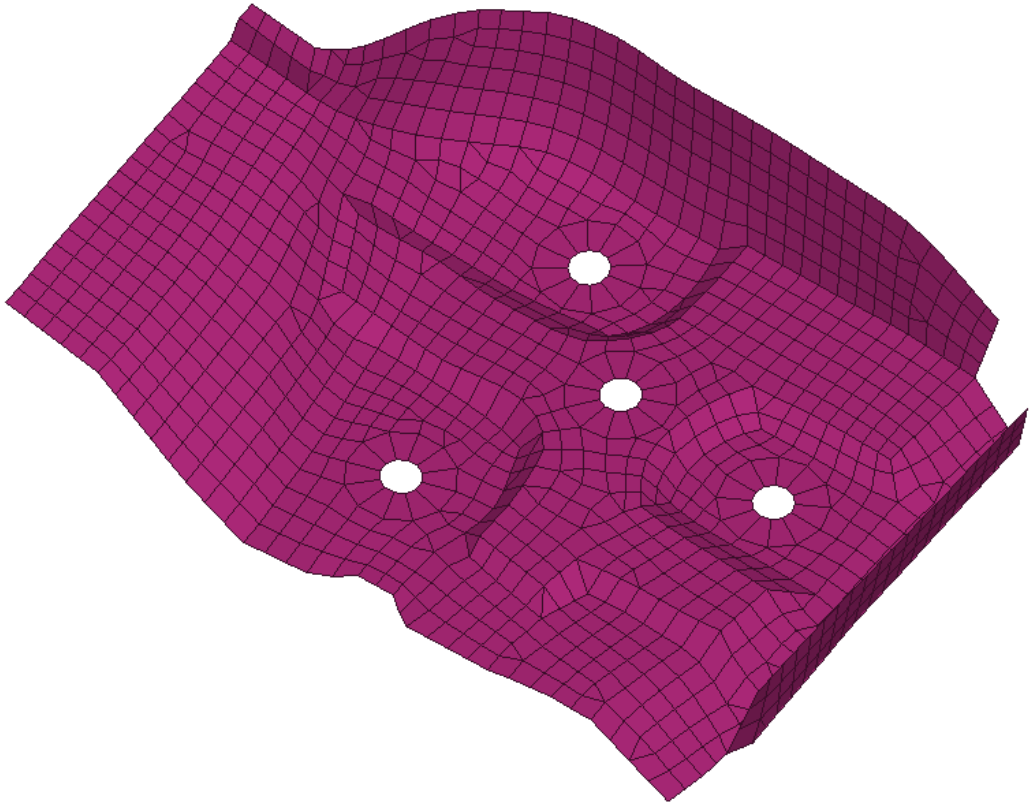


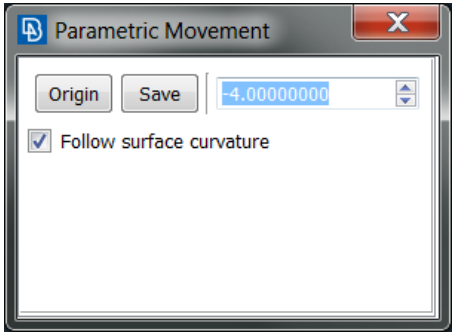


# Direct Morphing

## 2D & 3D Holes

Manipulate diameter of **2D Holes**

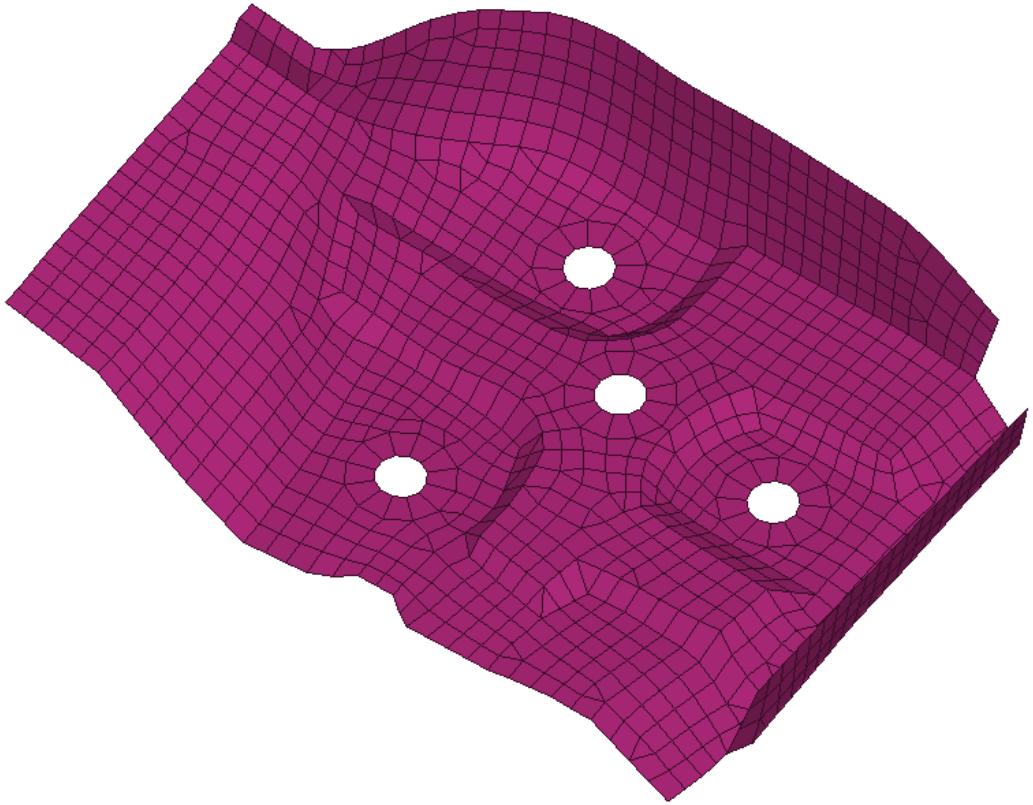


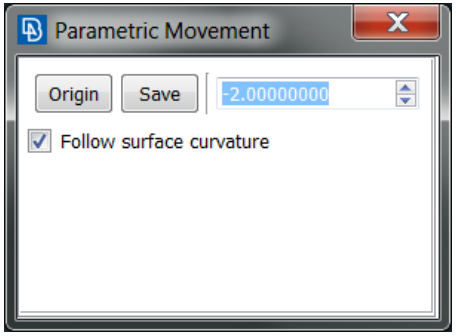


# Direct Morphing

## 2D & 3D Holes

Manipulate diameter of **2D Holes**

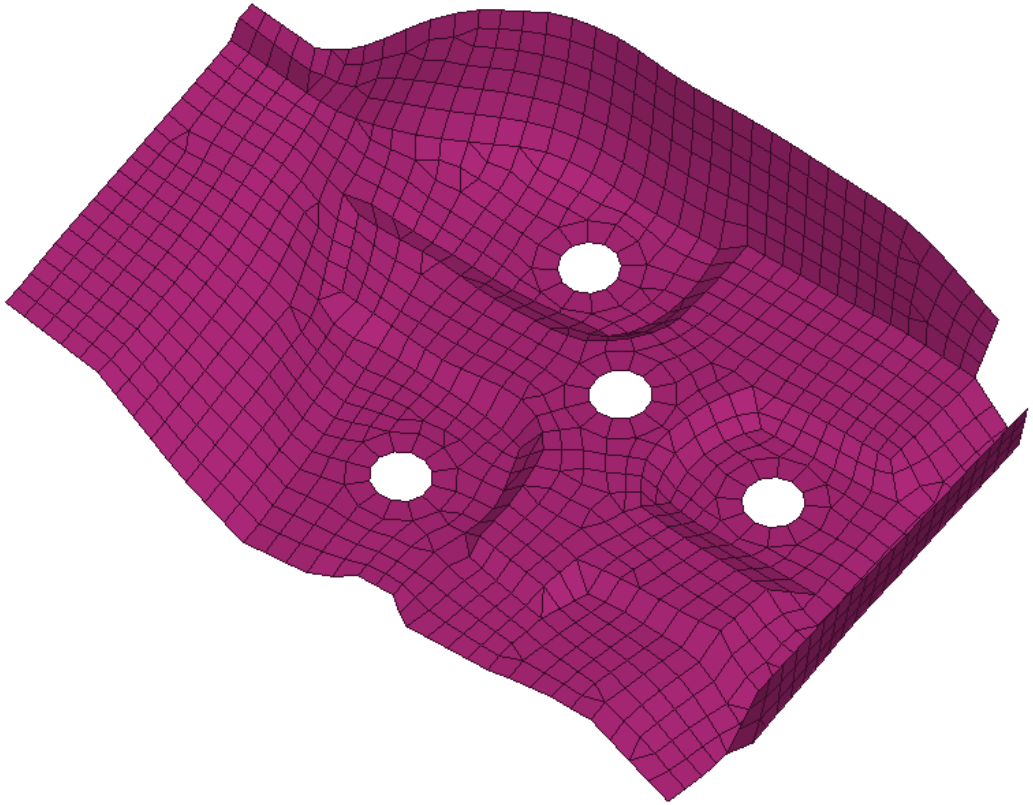


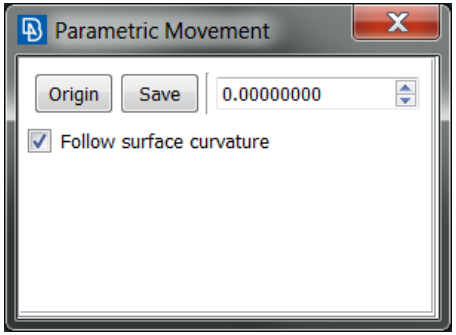


# Direct Morphing

## 2D & 3D Holes

Manipulate diameter of **2D Holes**

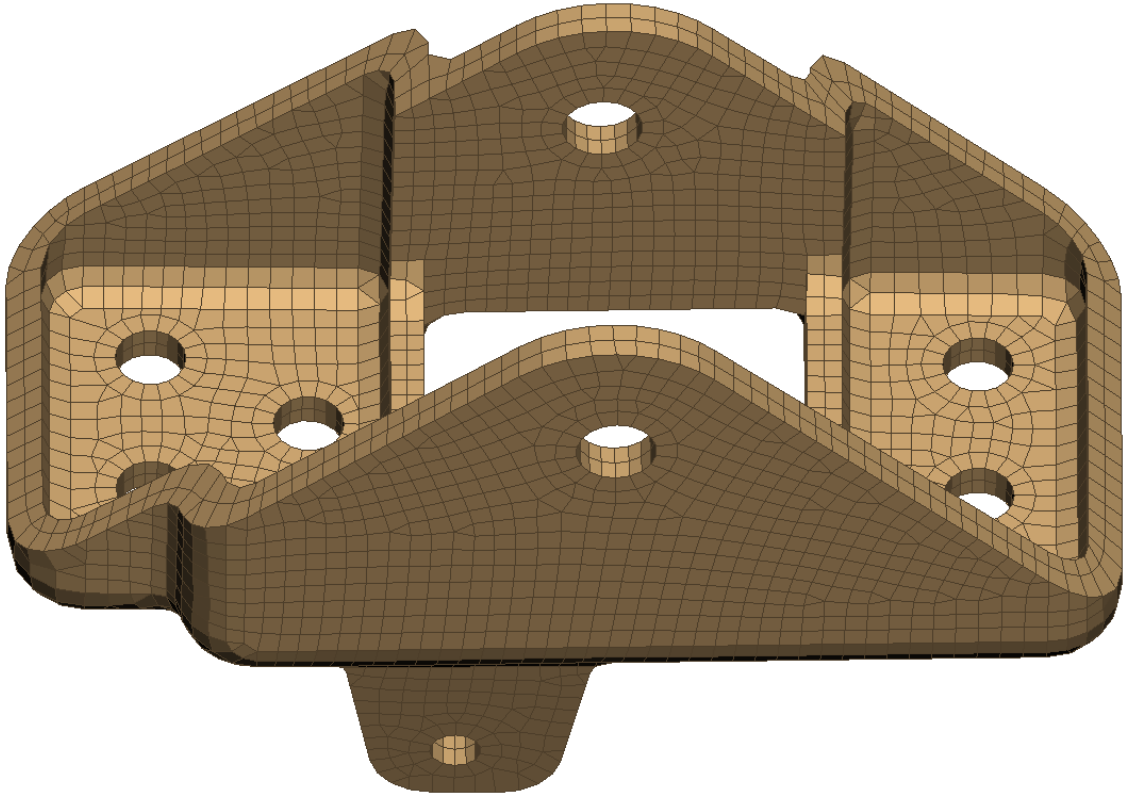




# Direct Morphing

## 2D & 3D Holes

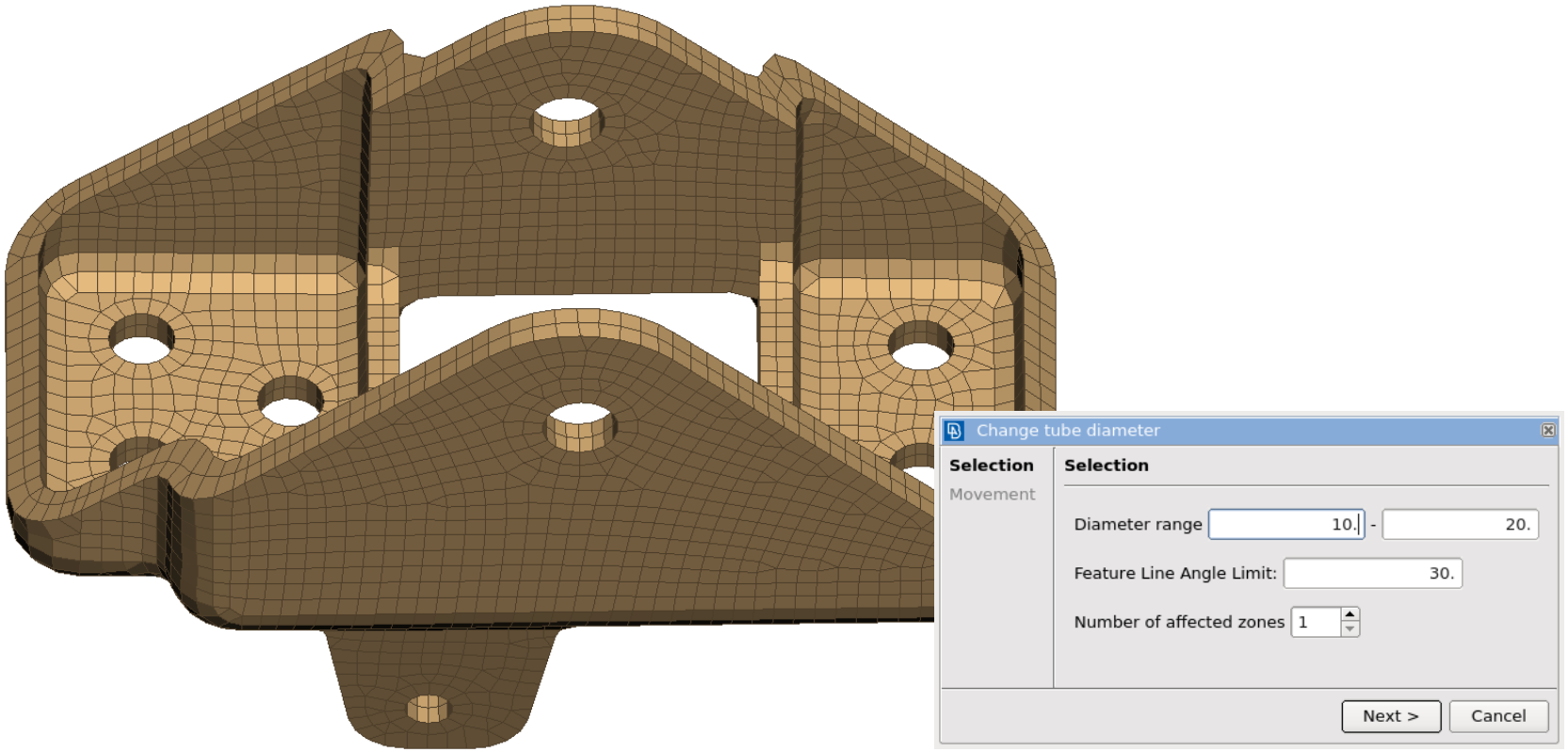
Manipulate diameter of **3D Holes**



# Direct Morphing

## 2D & 3D Holes

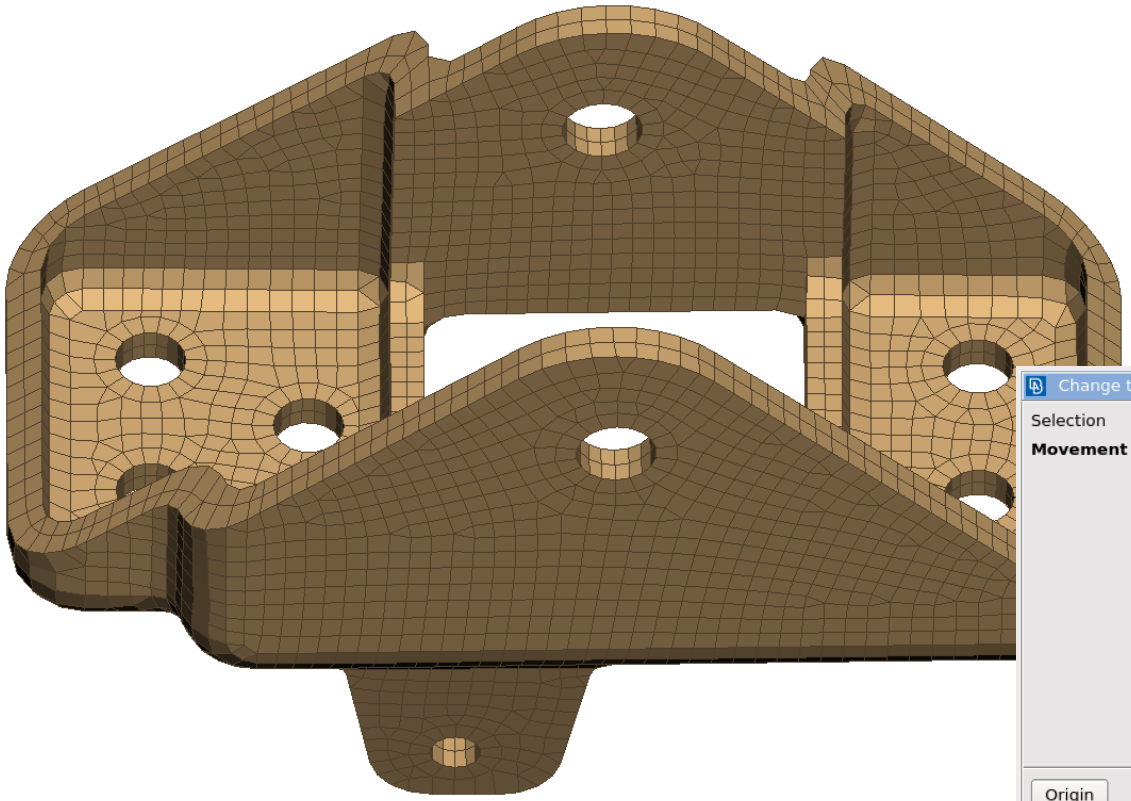
Manipulate diameter of **3D Holes**

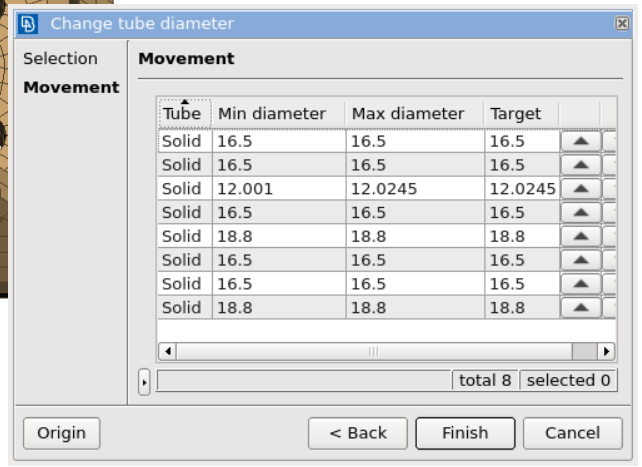


# Direct Morphing

## 2D & 3D Holes

Manipulate diameter of **3D Holes**

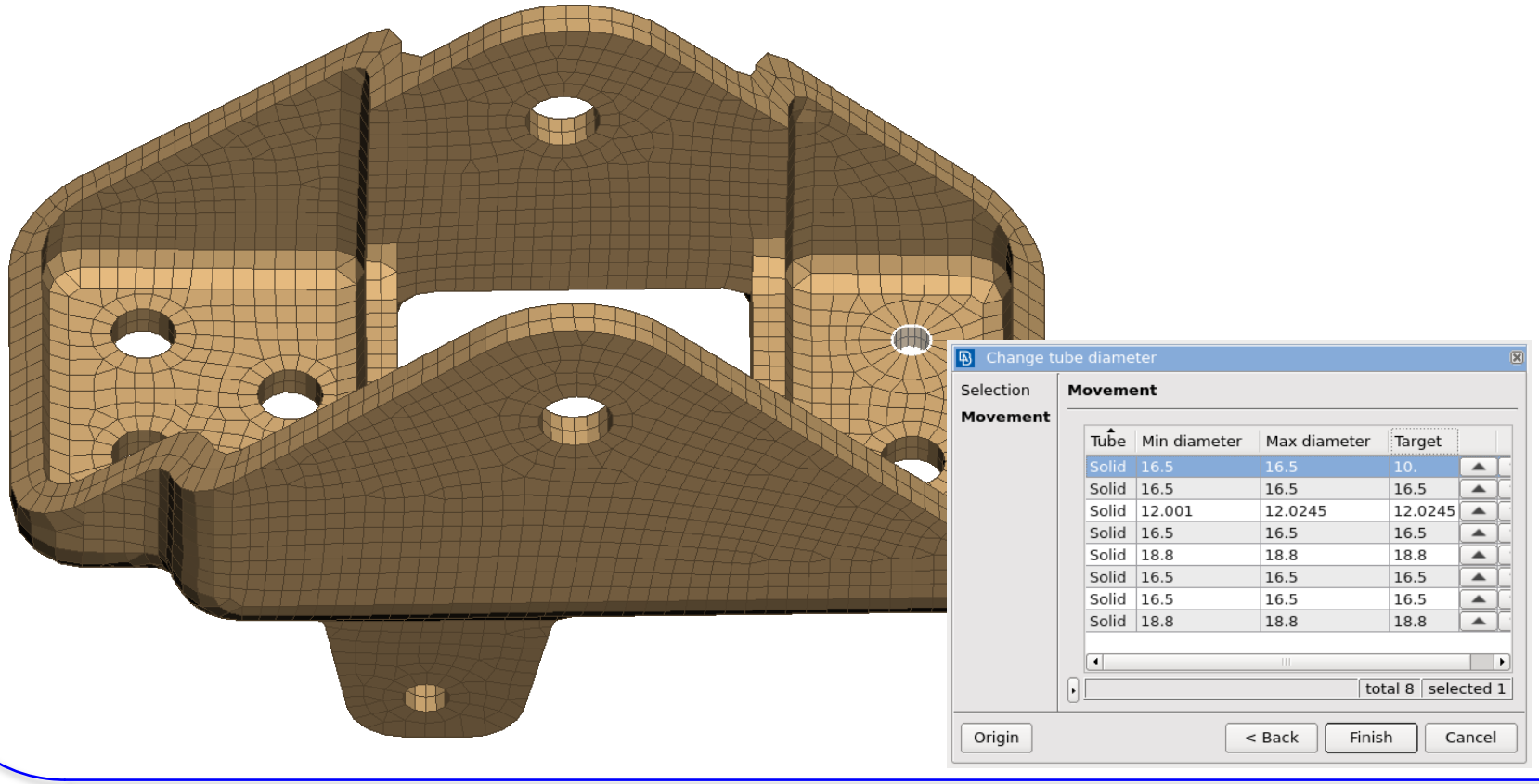




# Direct Morphing

## 2D & 3D Holes

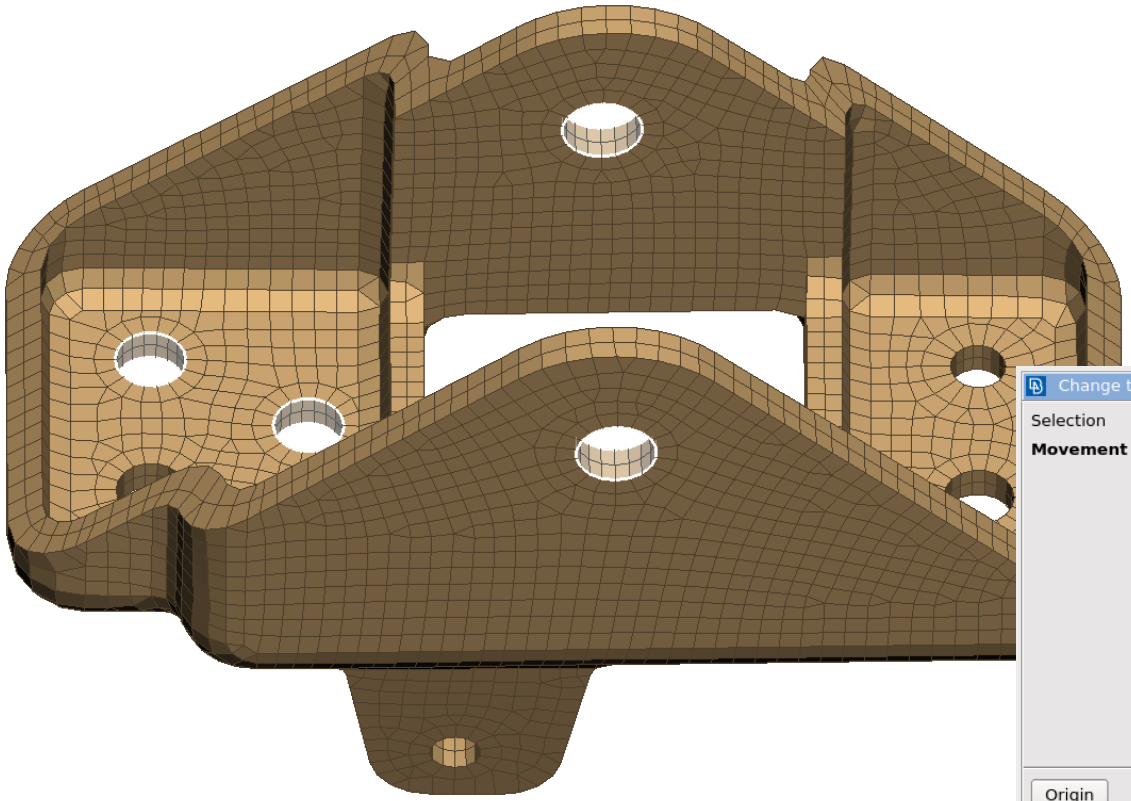
Manipulate diameter of **3D Holes**

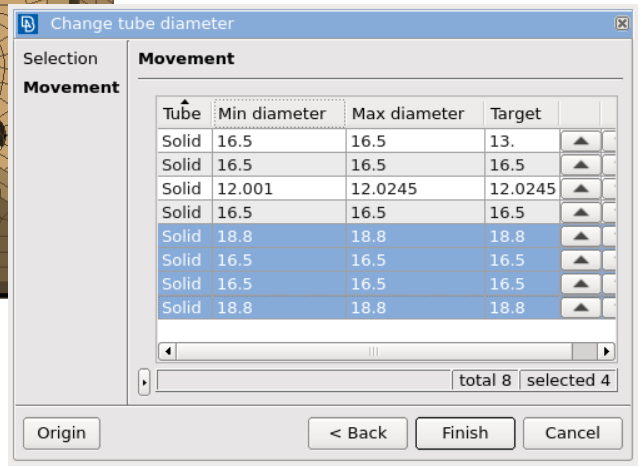


# Direct Morphing

## 2D & 3D Holes

Manipulate diameter of **3D Holes**

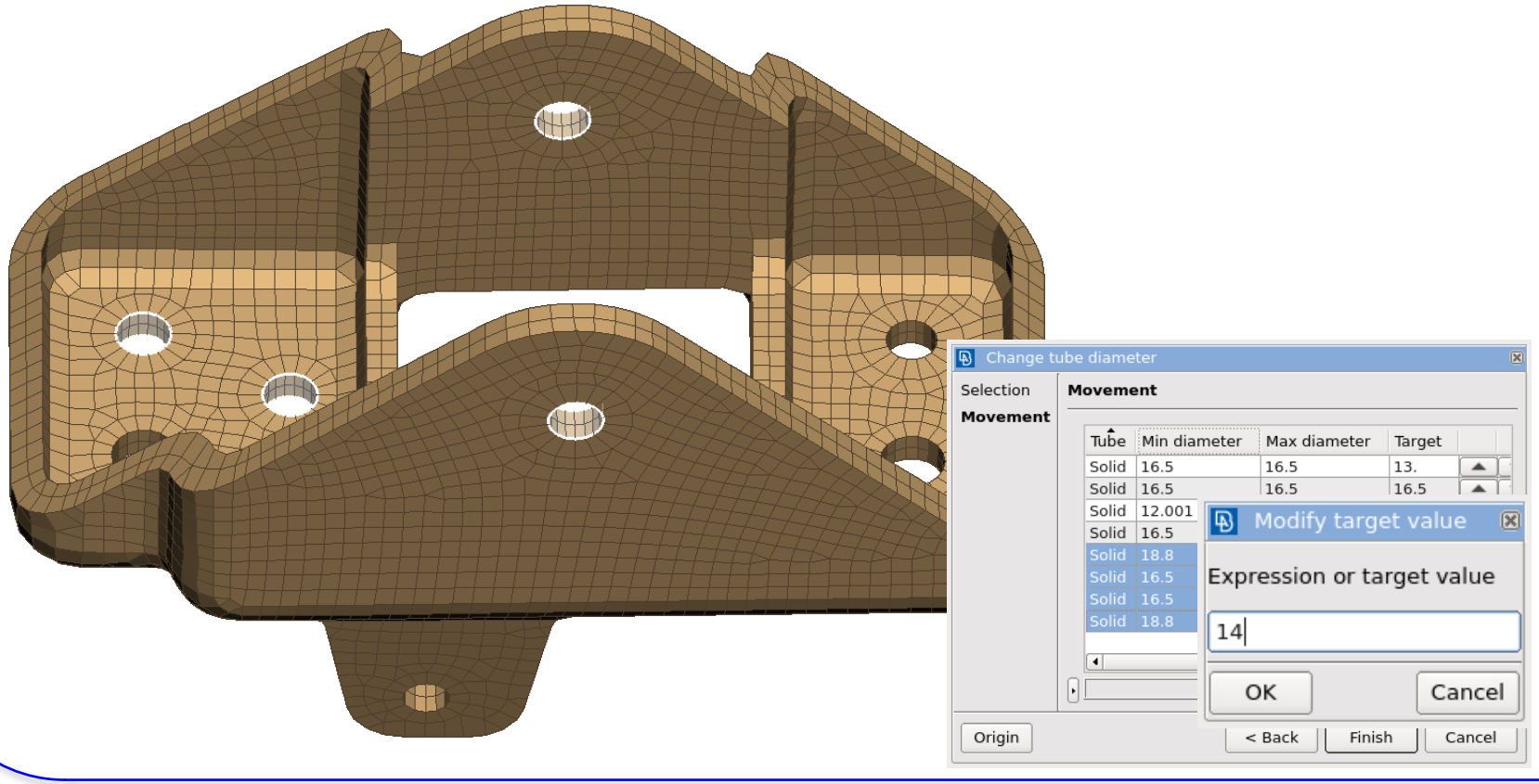




# Direct Morphing

## 2D & 3D Holes

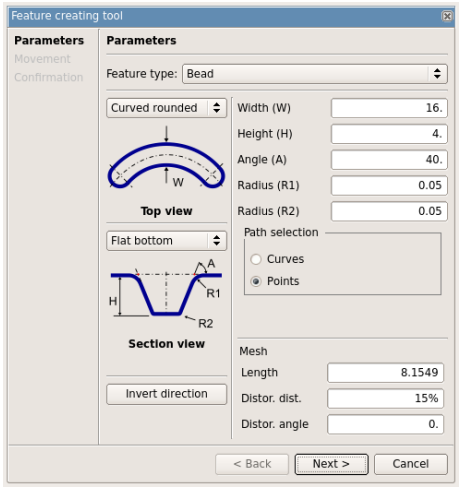
Manipulate diameter of **3D Holes**

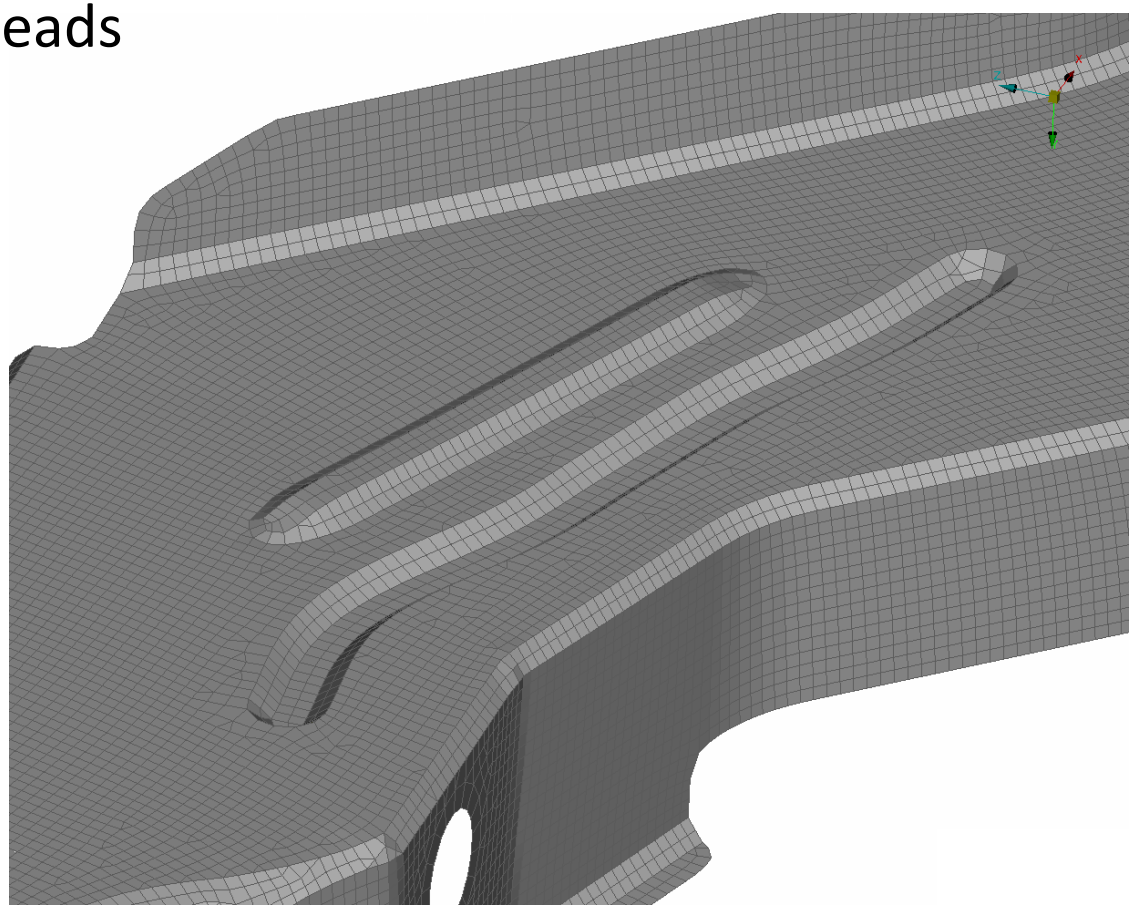


# Direct Morphing

## Generation & modification of beads and embosses

- Curved & Rounded Beads

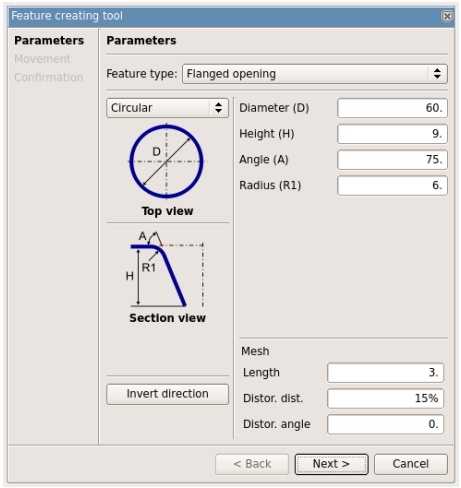


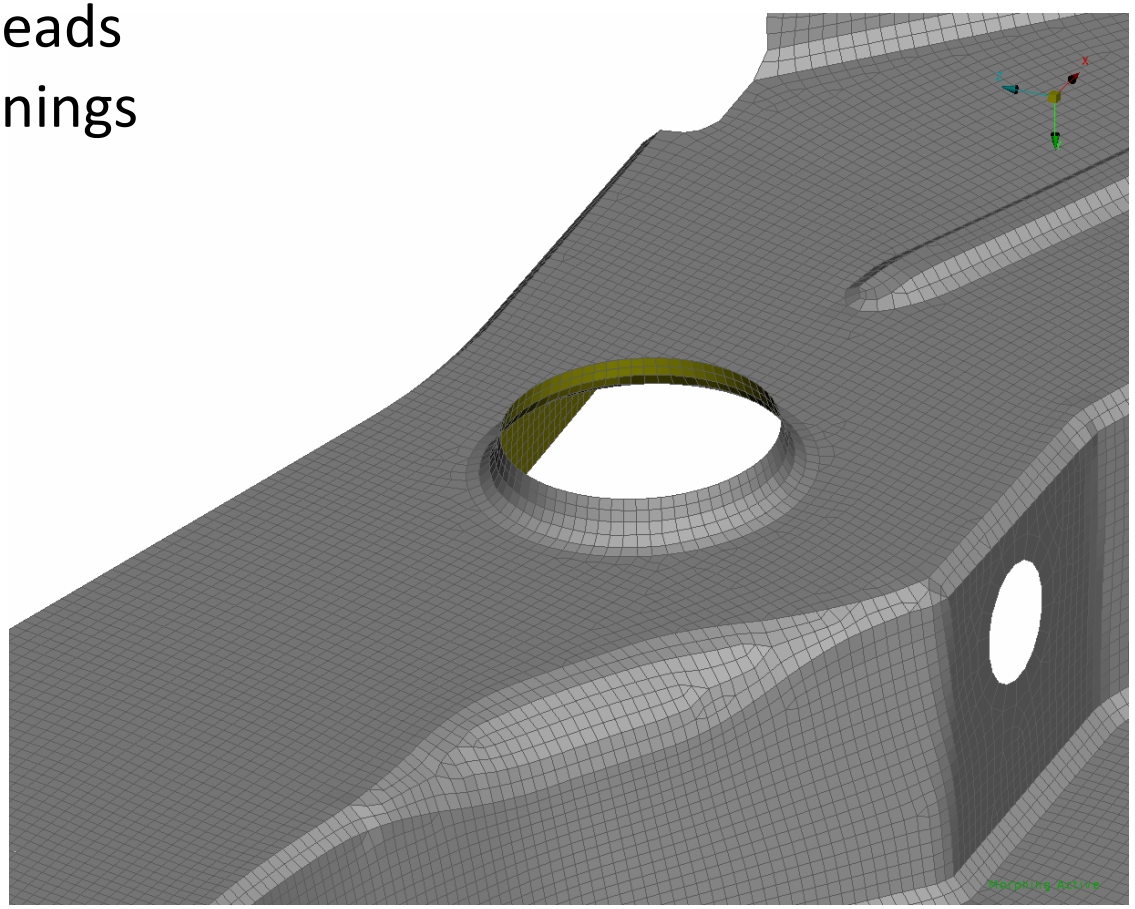



# Direct Morphing

## Generation & modification of beads and embosses

- Curved & Rounded Beads
- Circular Flanged Openings

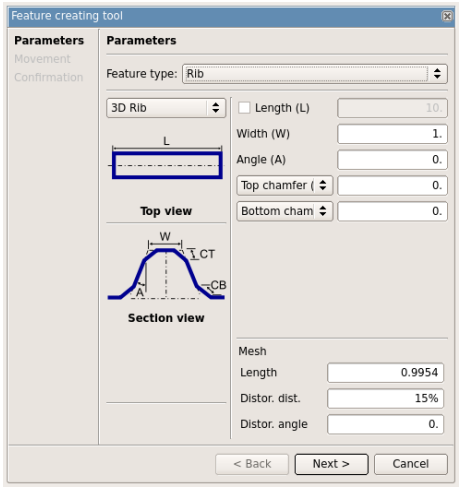


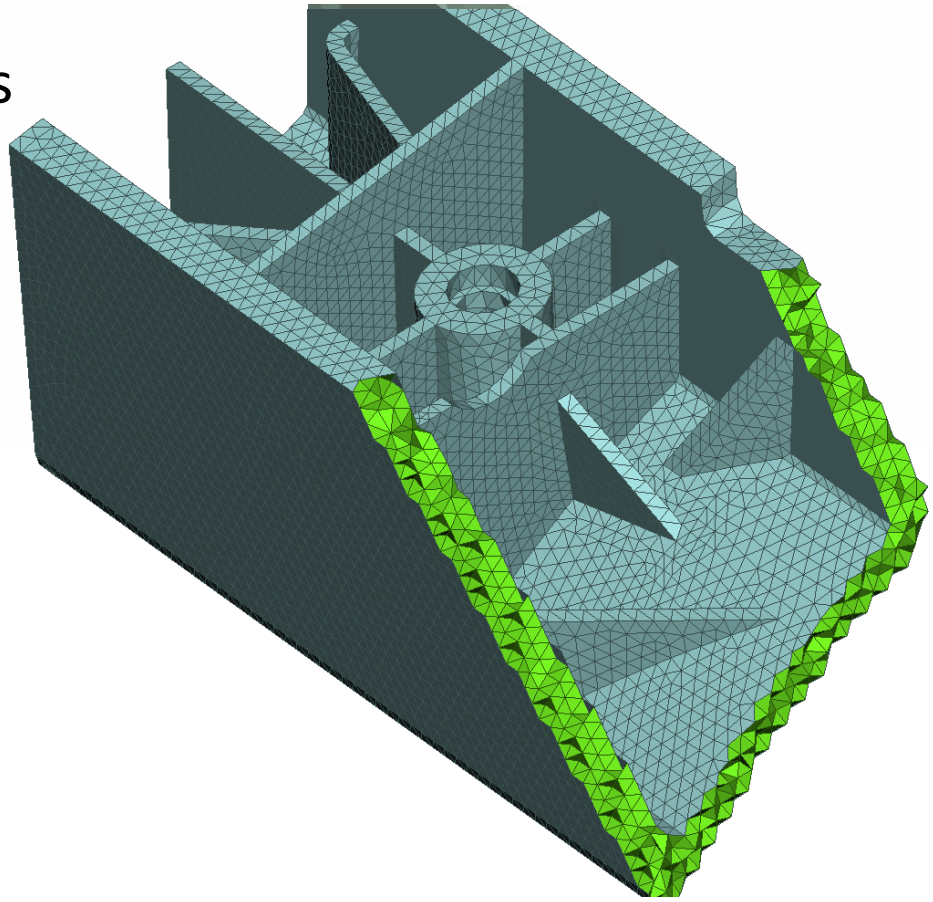



# Direct Morphing

## Generation & modification of beads and embosses

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

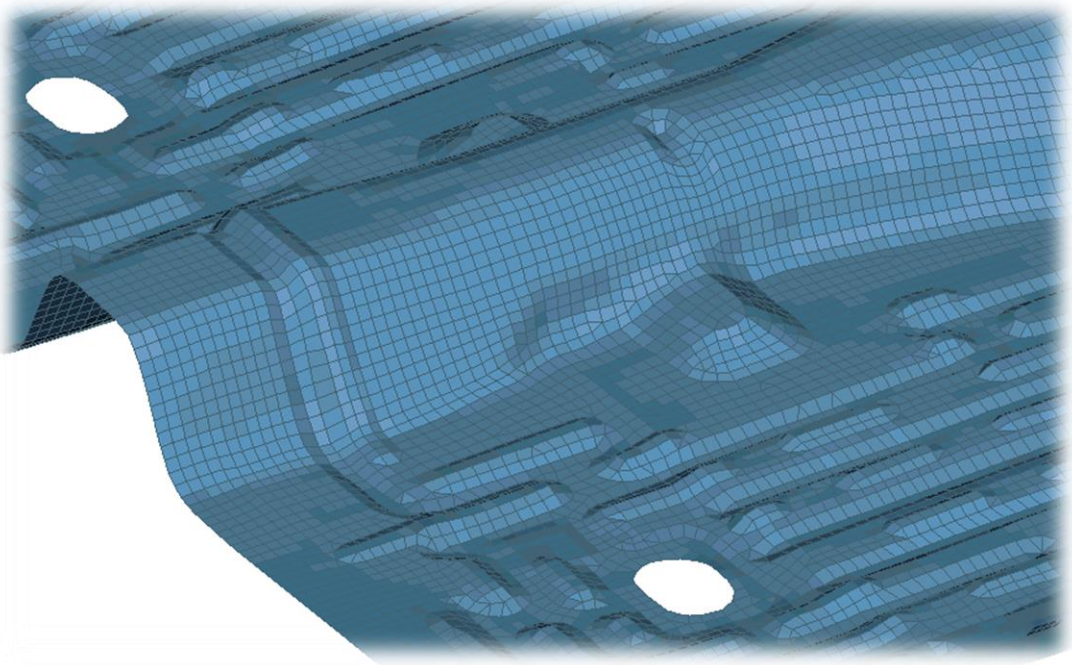


# Direct Morphing

## Design Change: Feature Slide/Copy

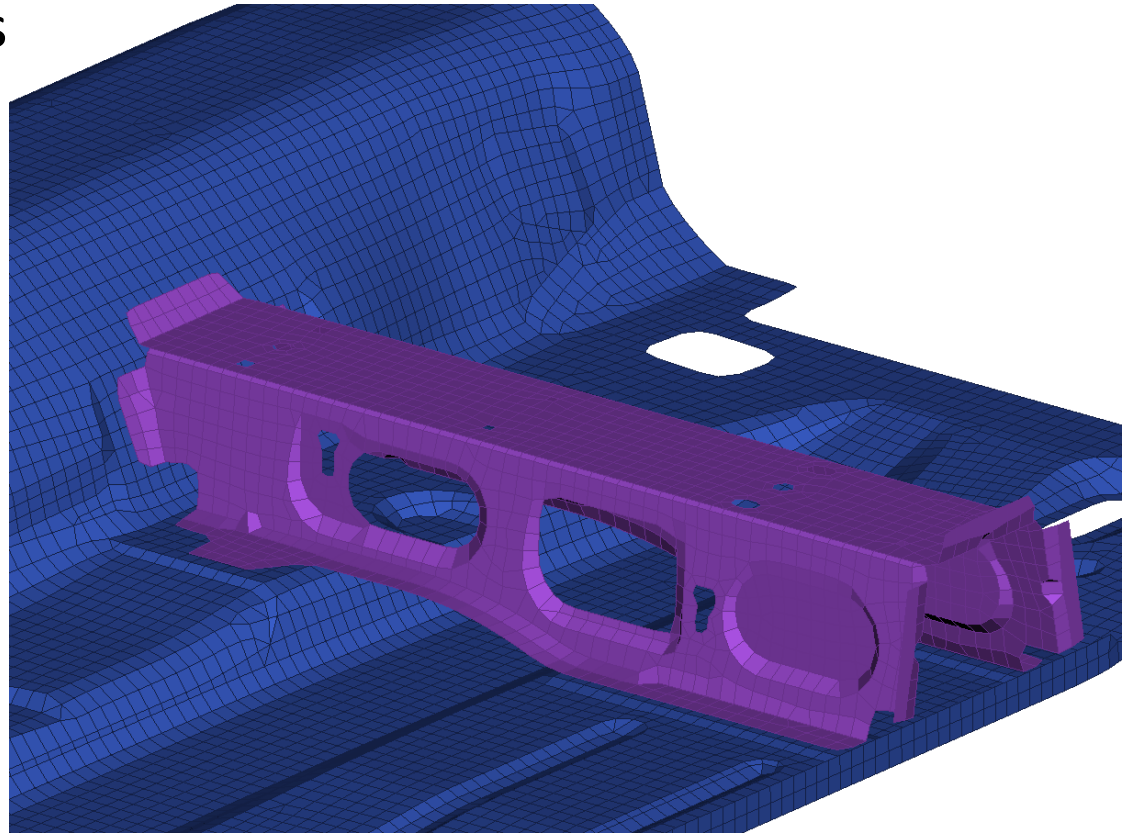
- Features of any shape (e.g. holes, beads, ribs) can be moved or copied on underlying surface
- Mesh of origin and target areas is reconstructed



# Direct Morphing

## Design Change: Position

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



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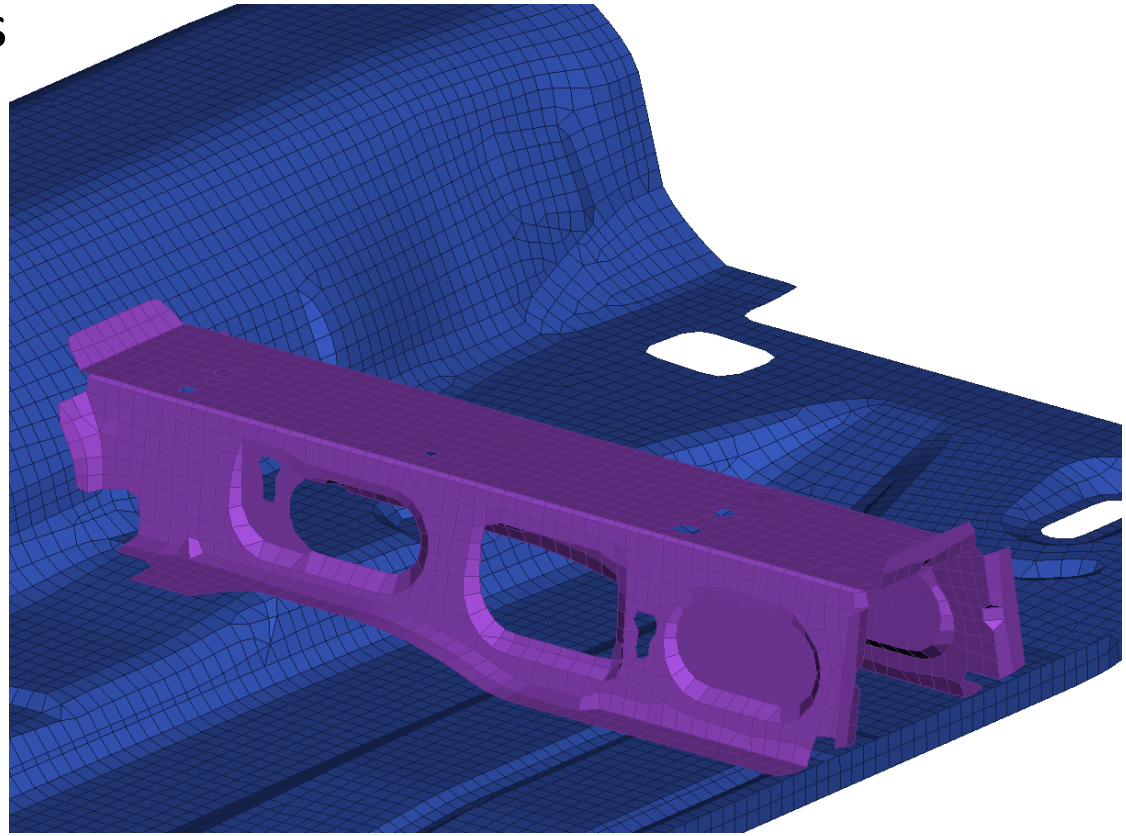
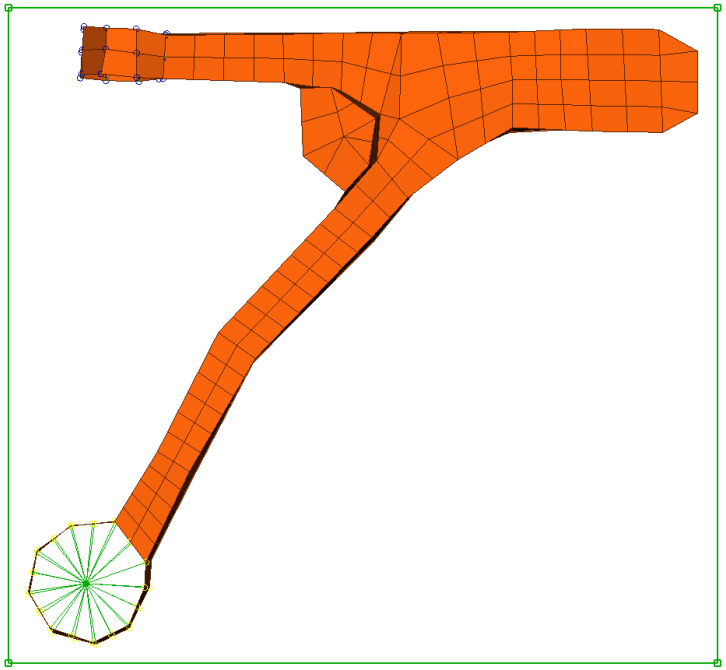
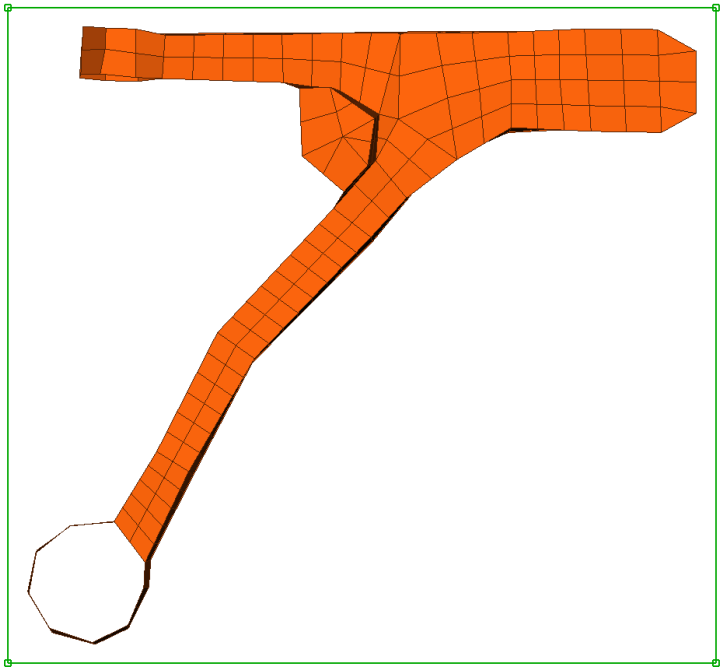


# Morphing Constraints

- 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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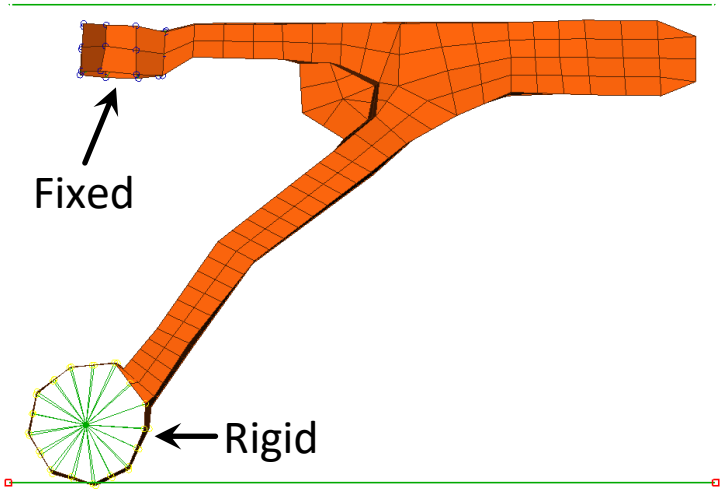
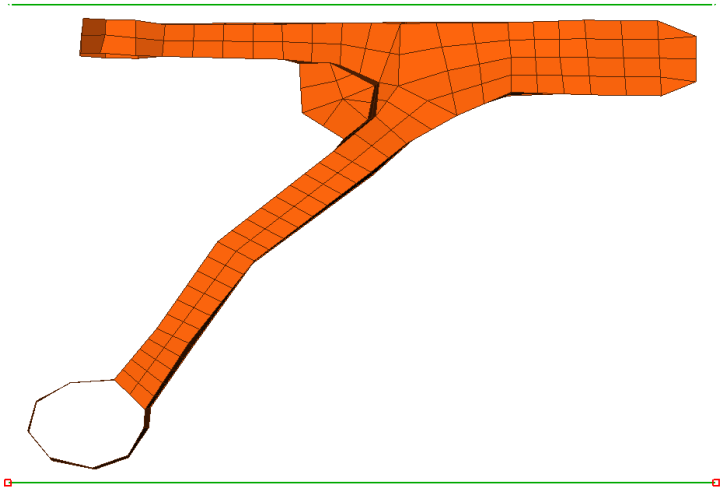



With Constraints



Without Constraints

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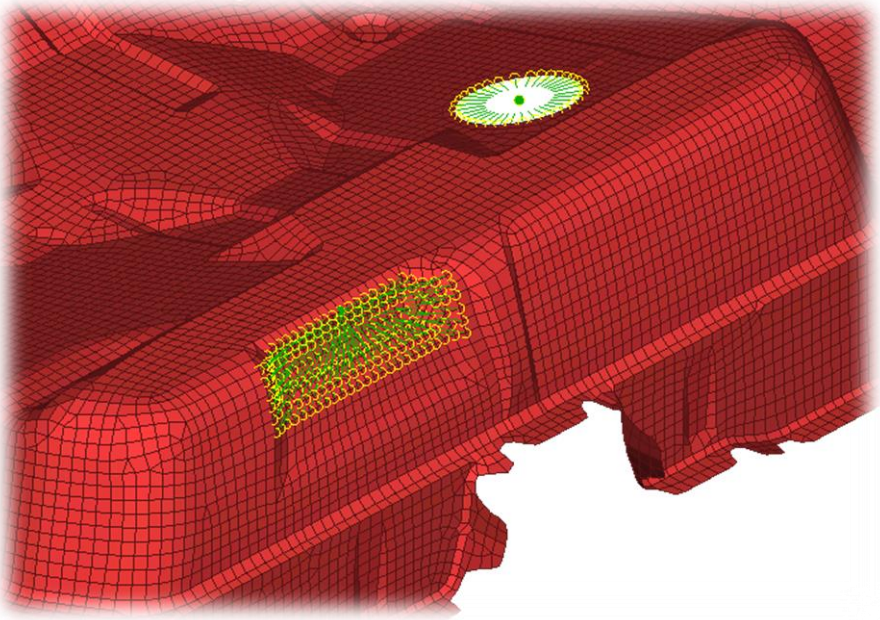

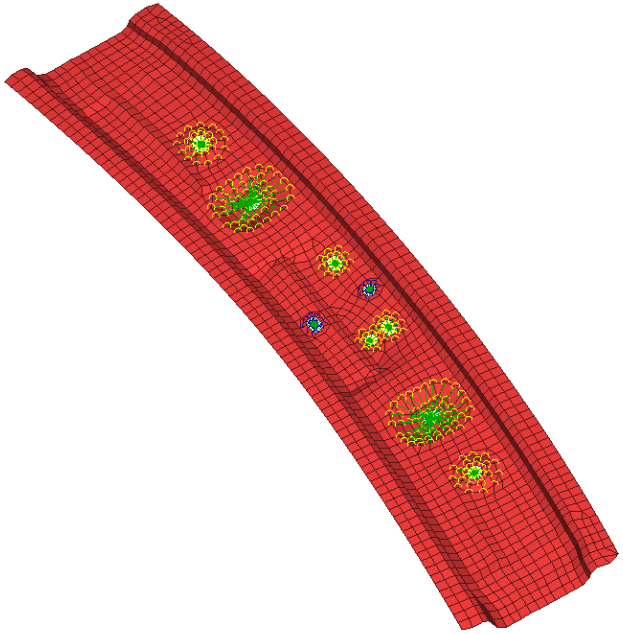

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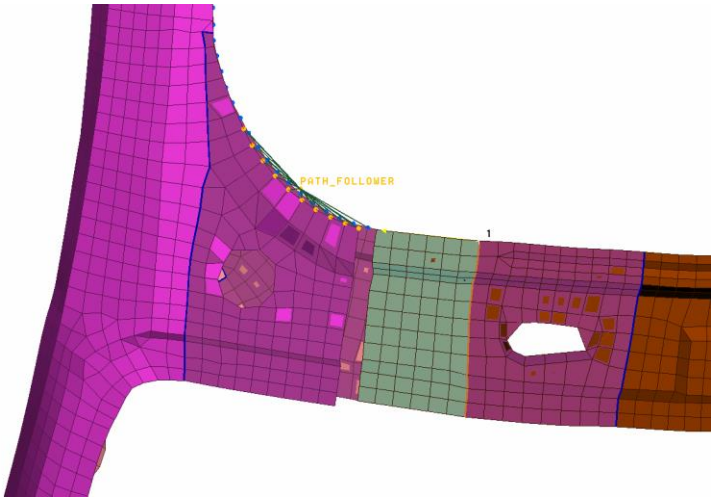
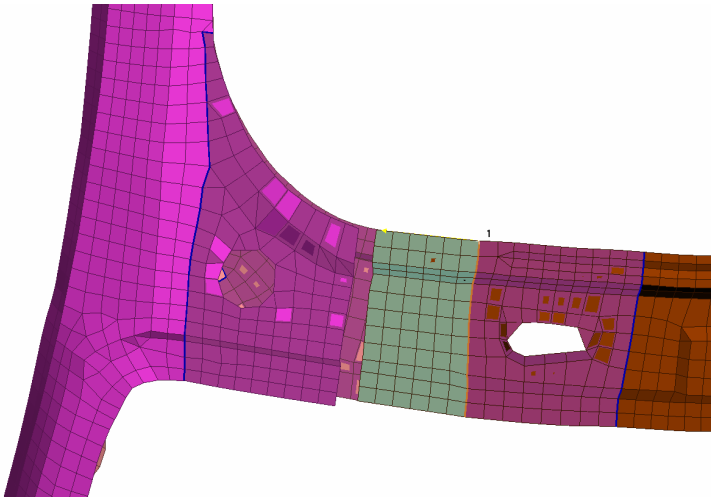



With Path Follower Constraint



Without Constraint

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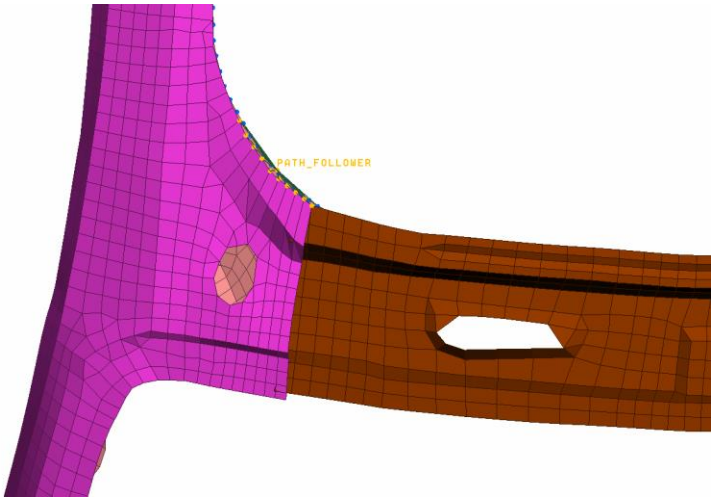
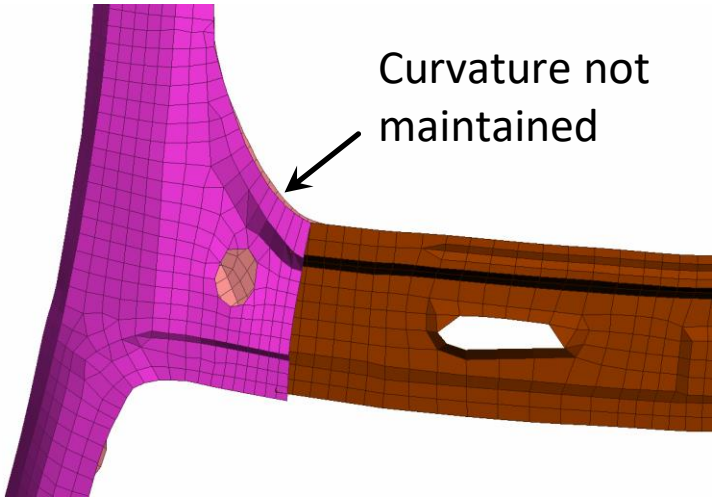



With Path Follower Constraint




Without Constraint

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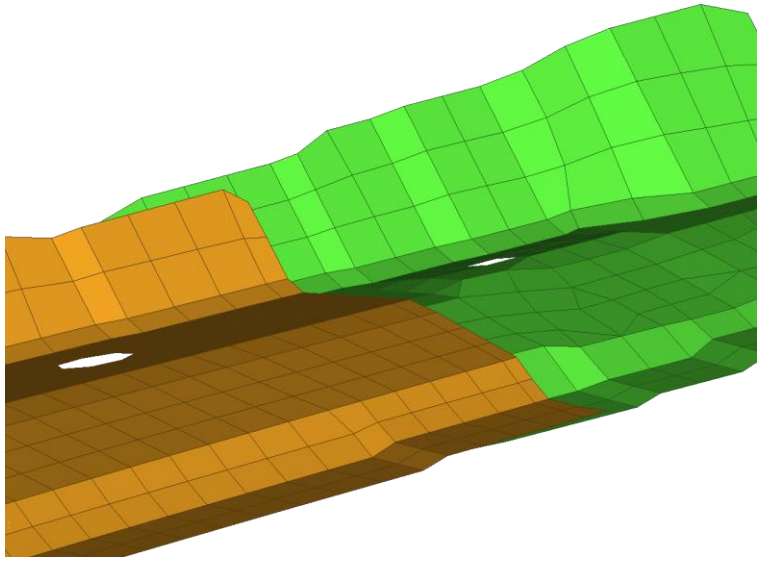
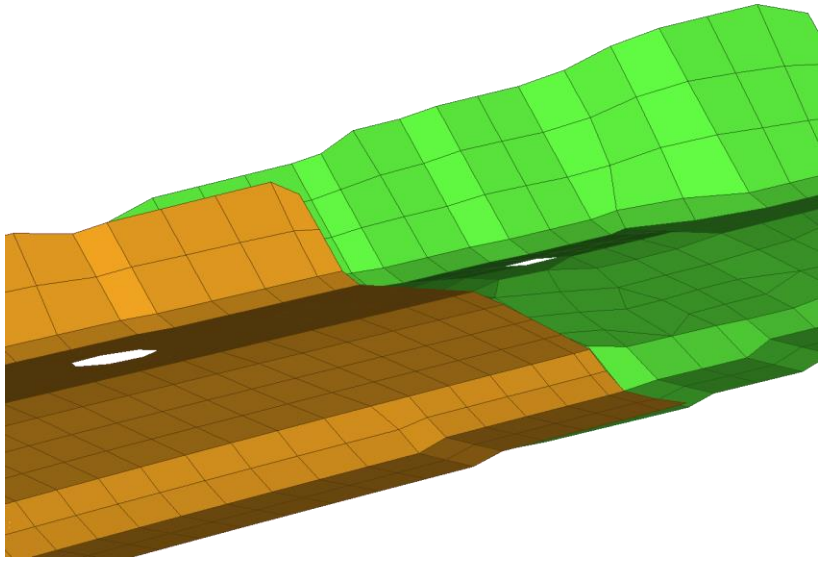


With Flange Constraint



Without Constraint

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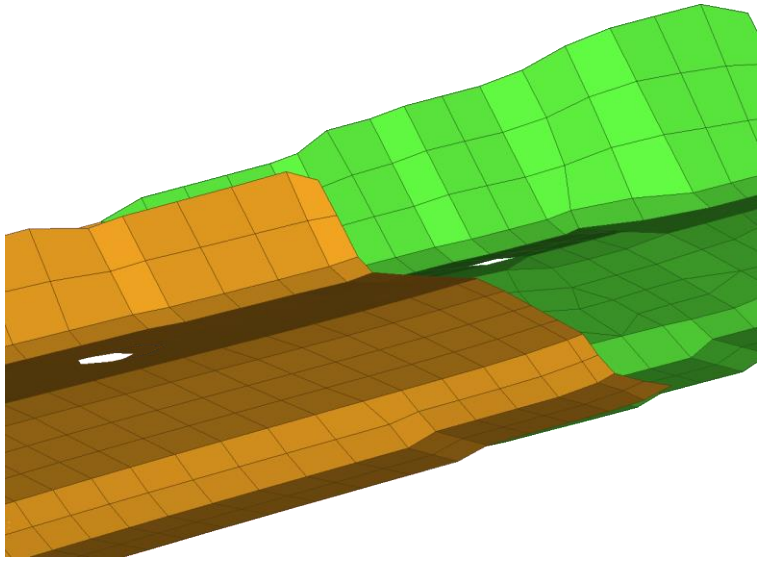
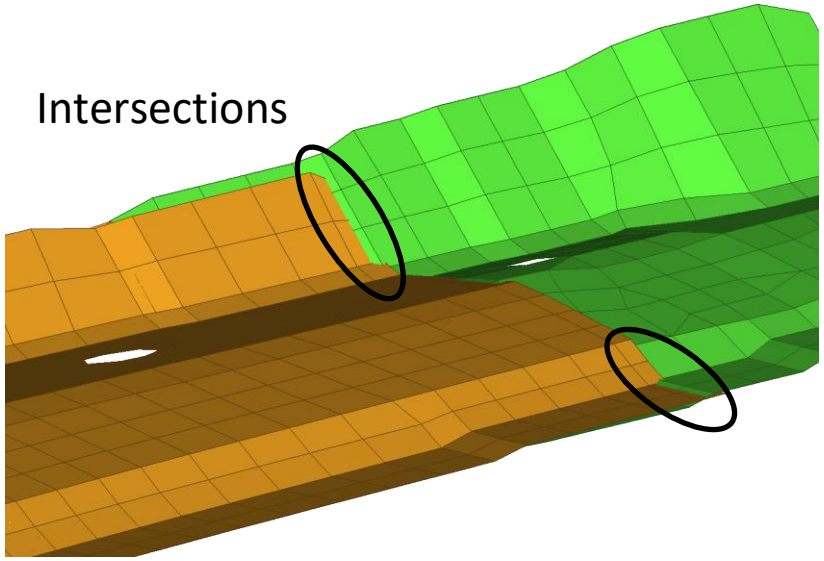


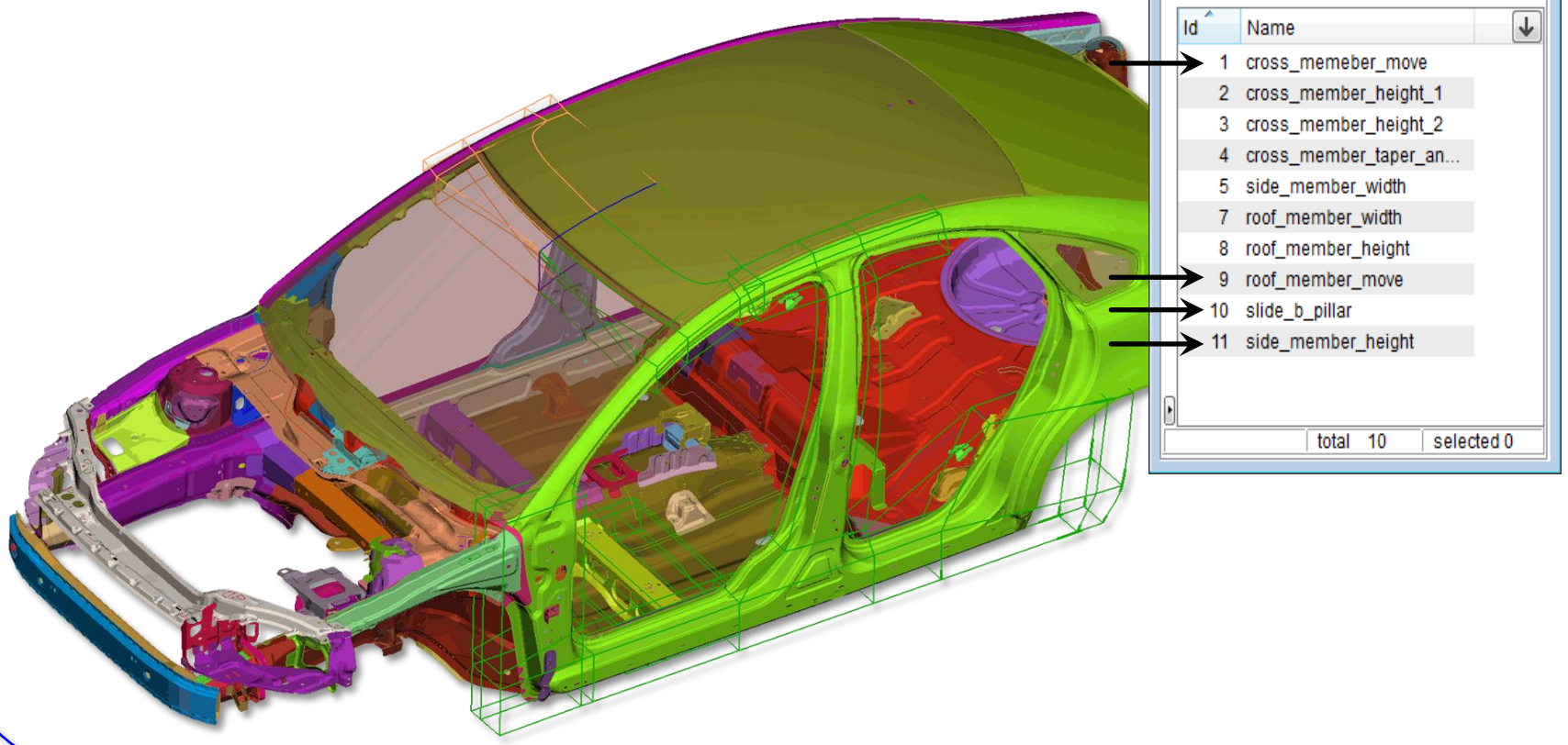
With Flange Constraint




Without Constraint

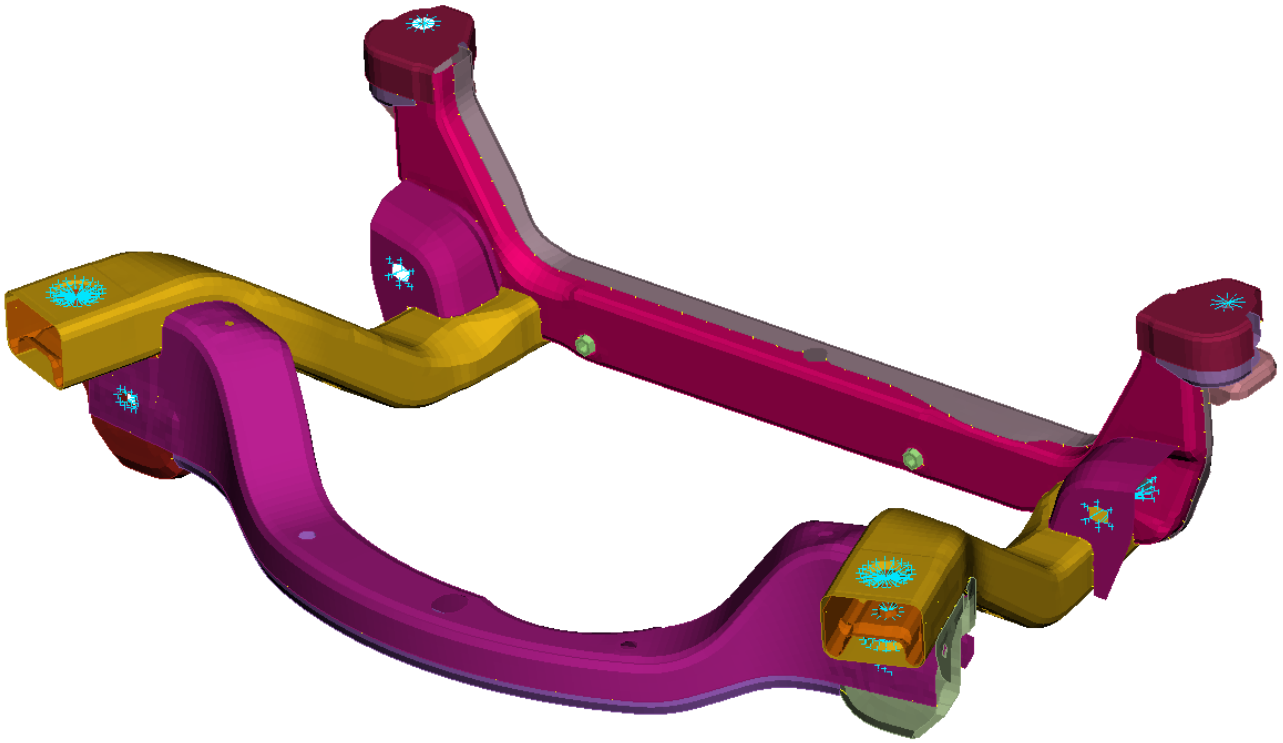
# Morphing Parameters

- For Box and Direct Morphing



# Morphing Parameters

## Video Recording



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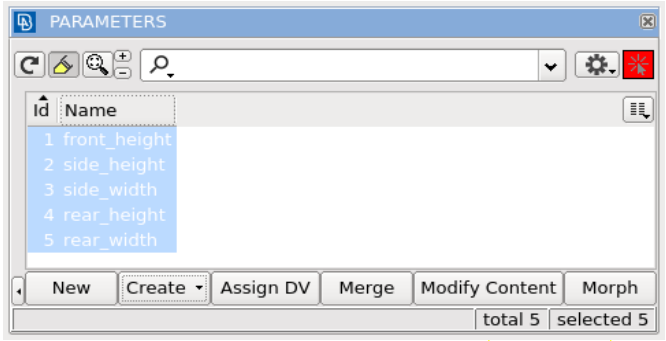


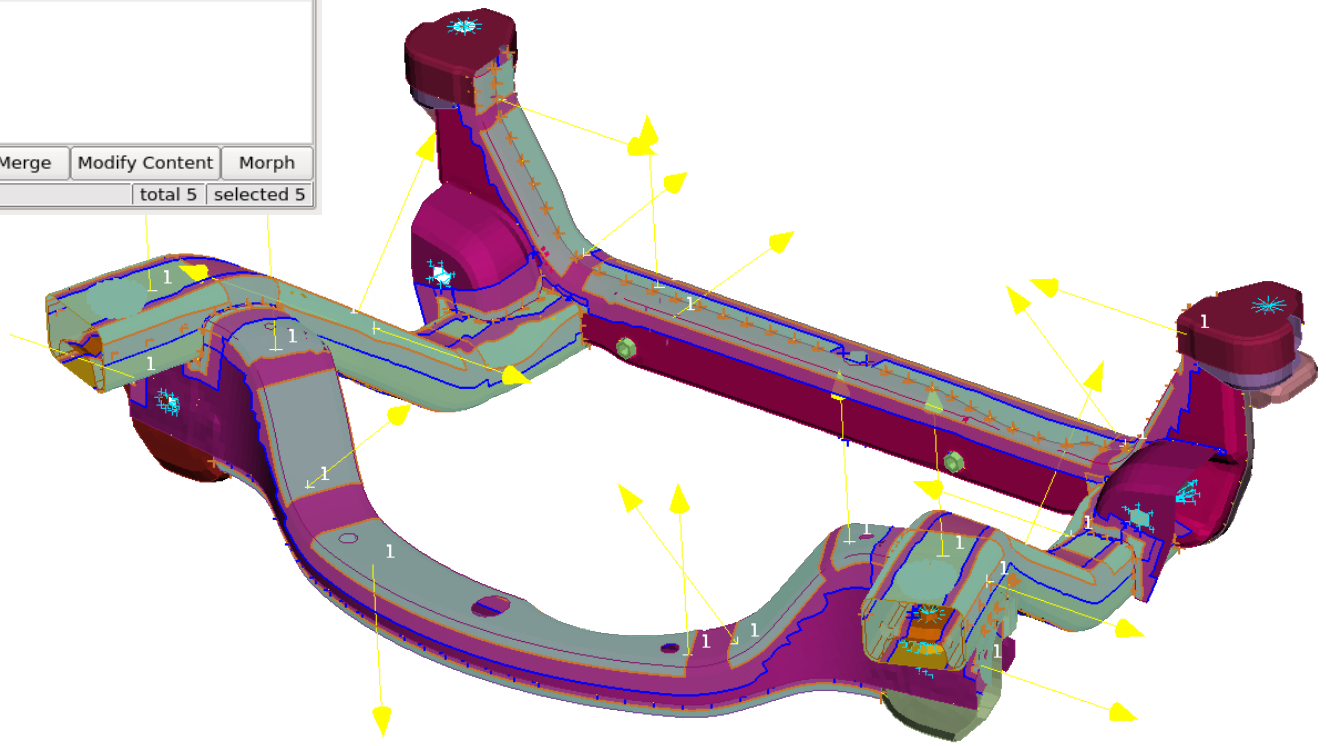

# Morphing Parameters

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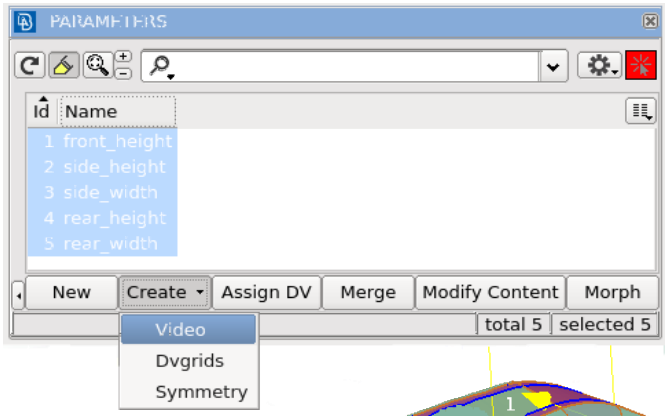


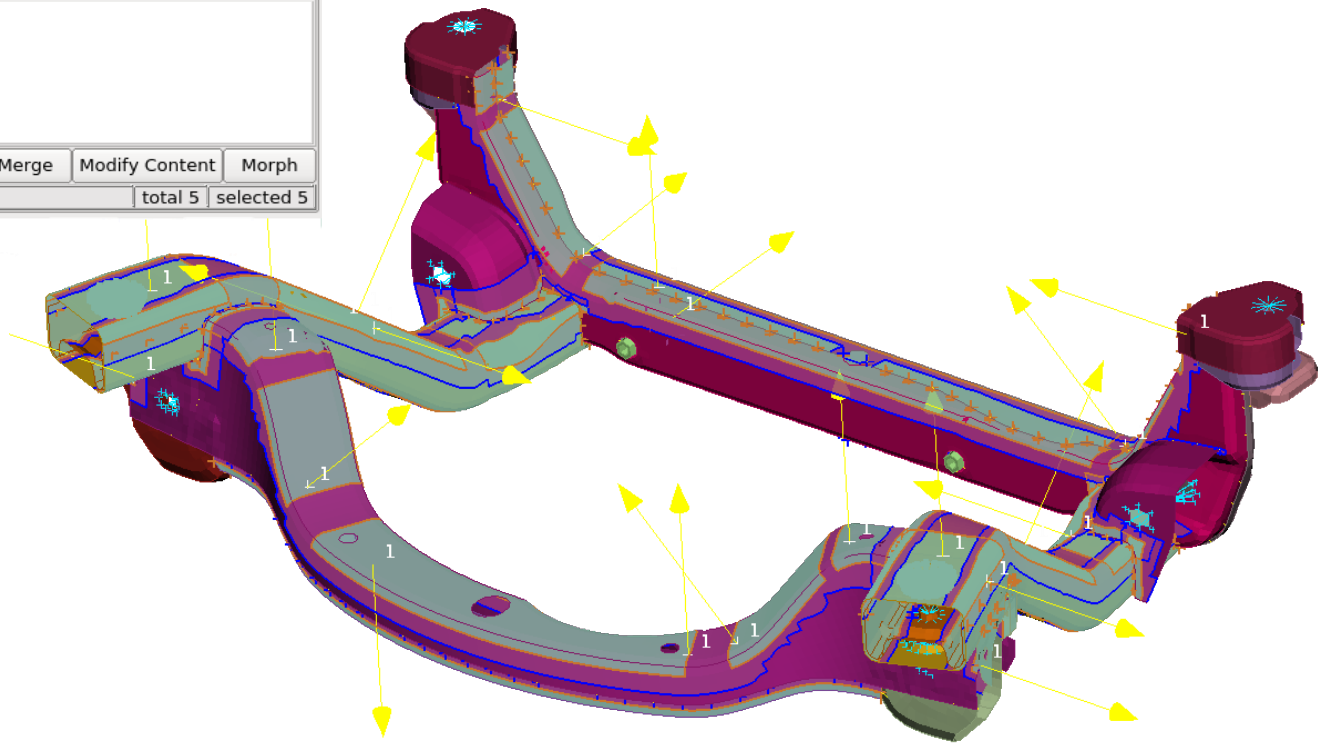

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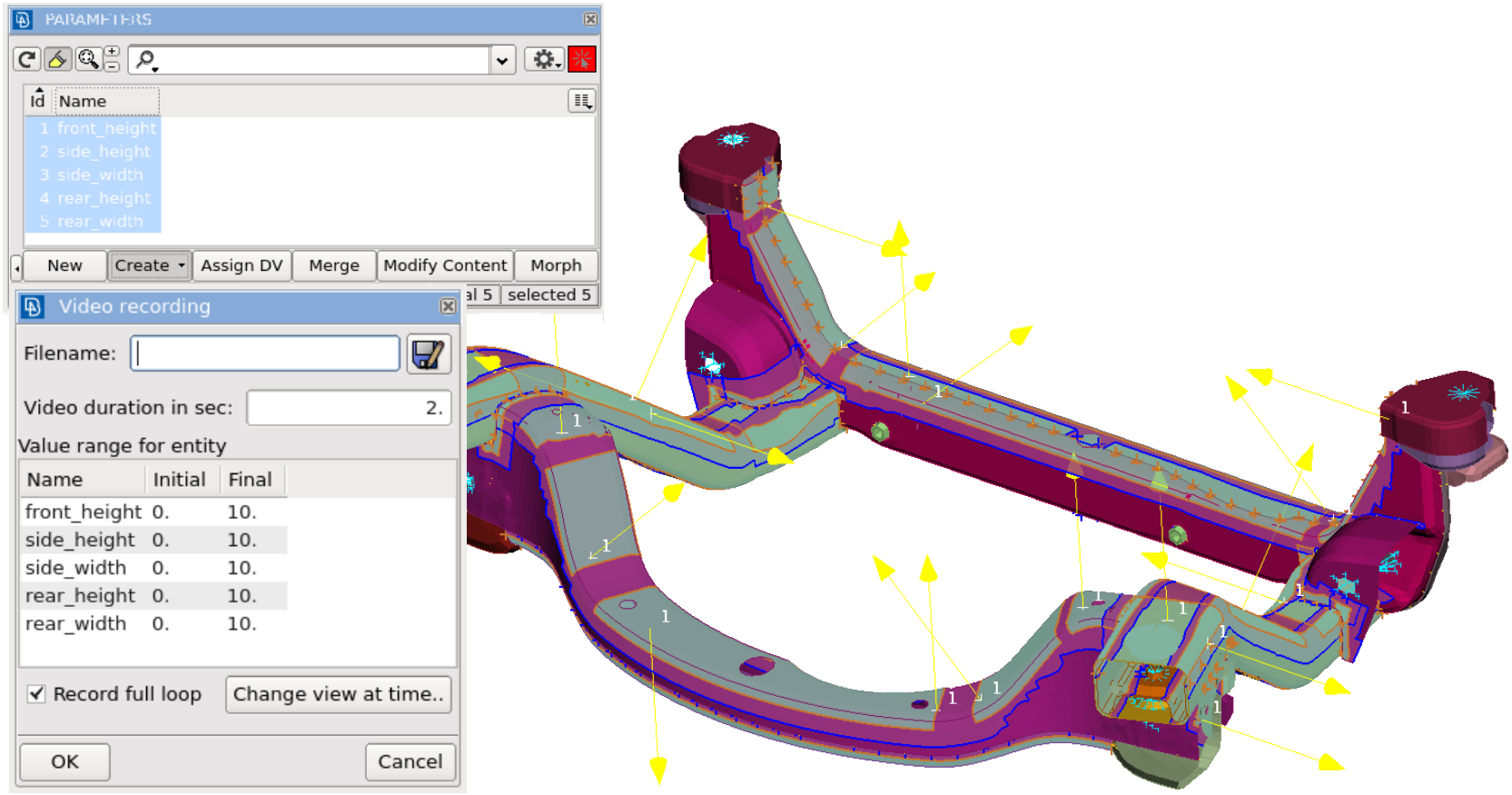

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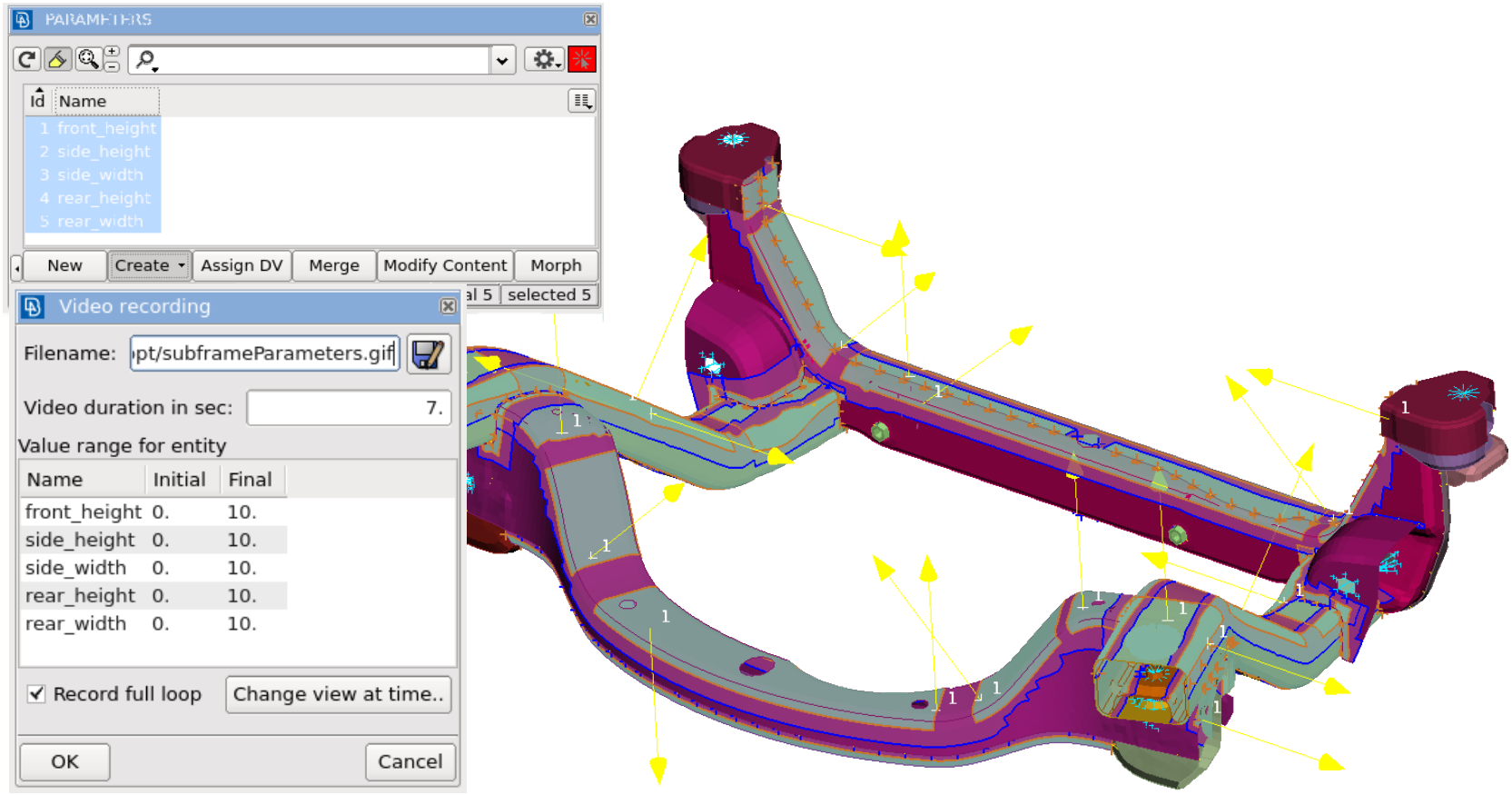

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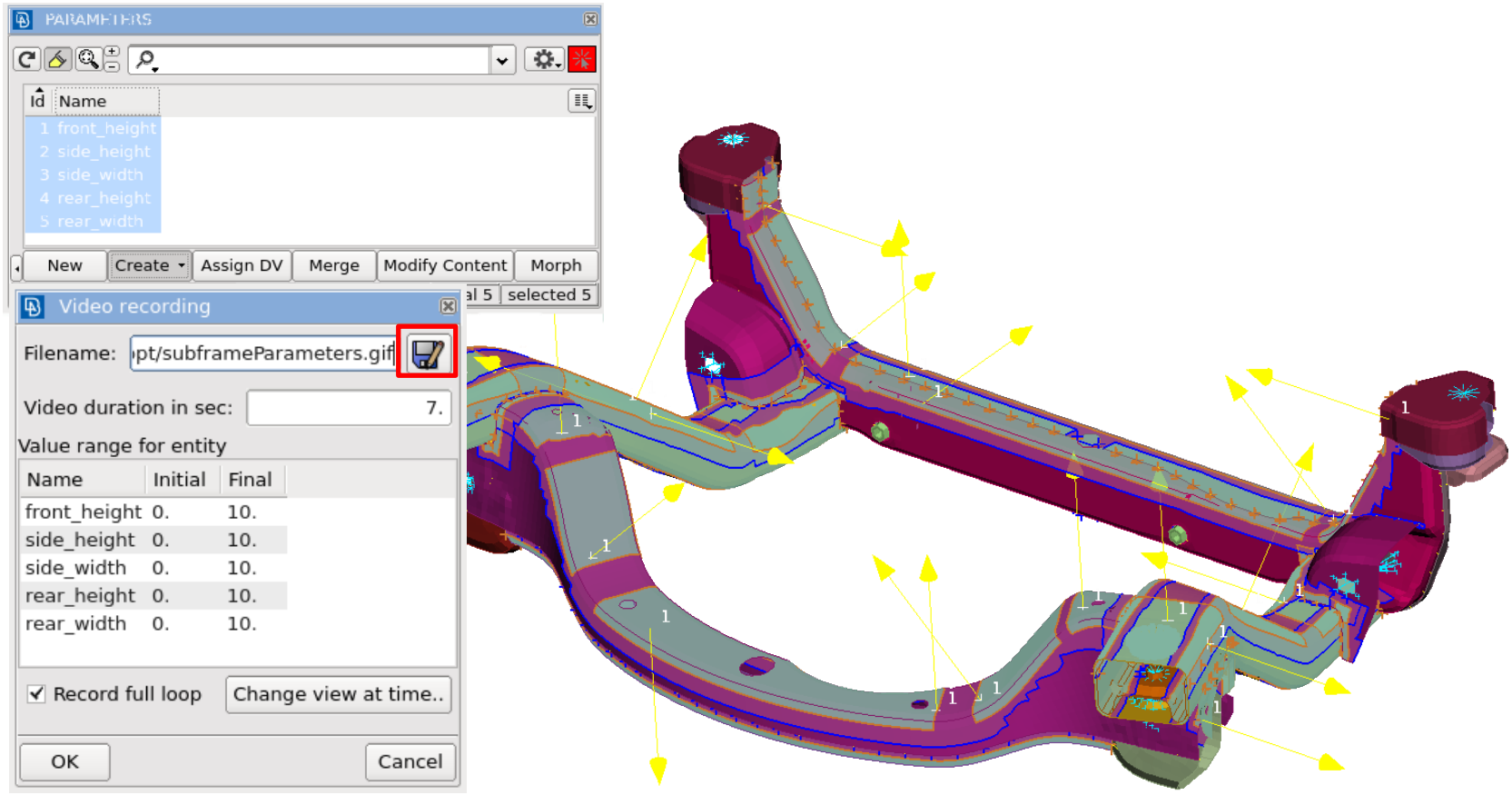

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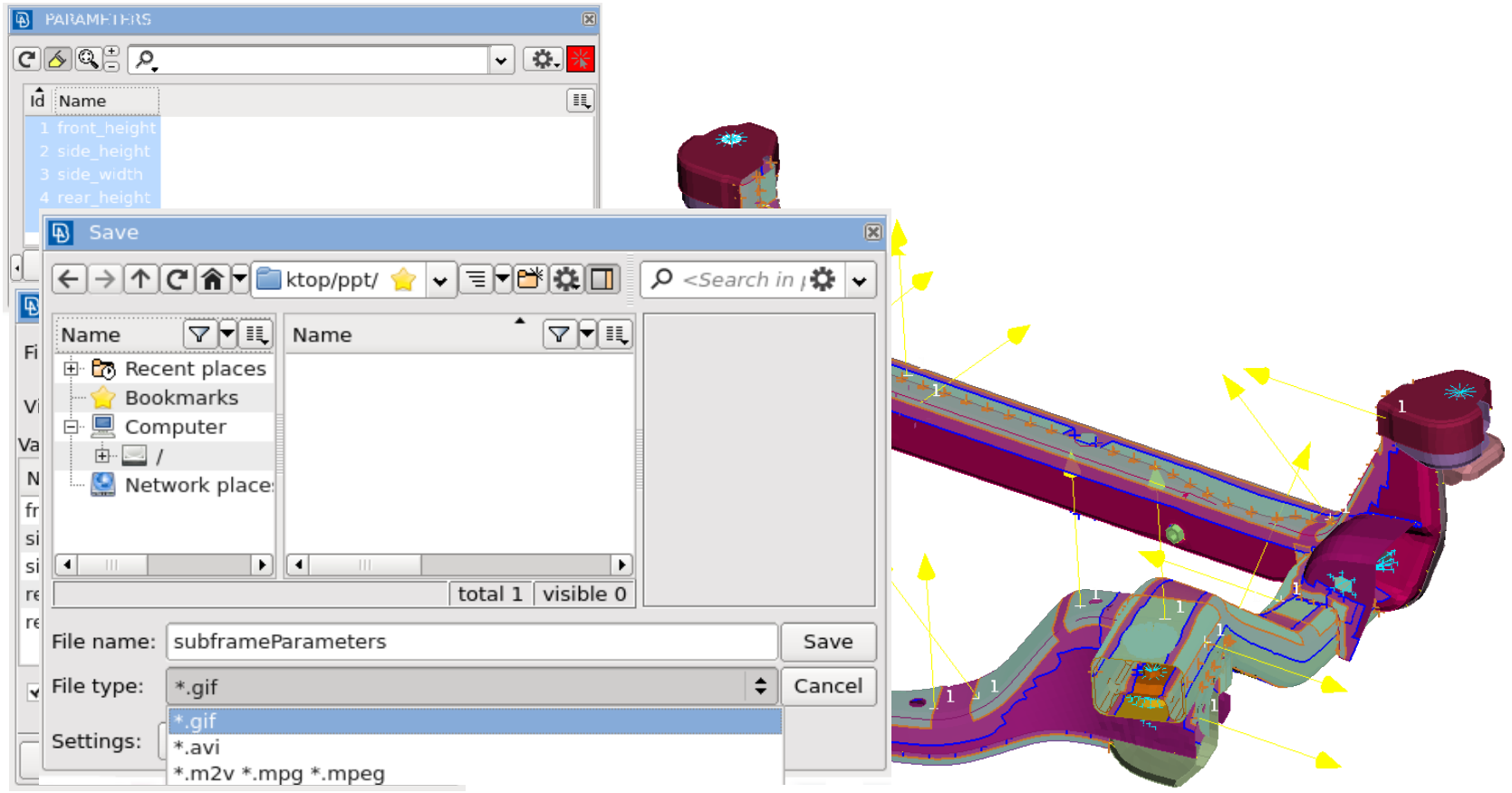

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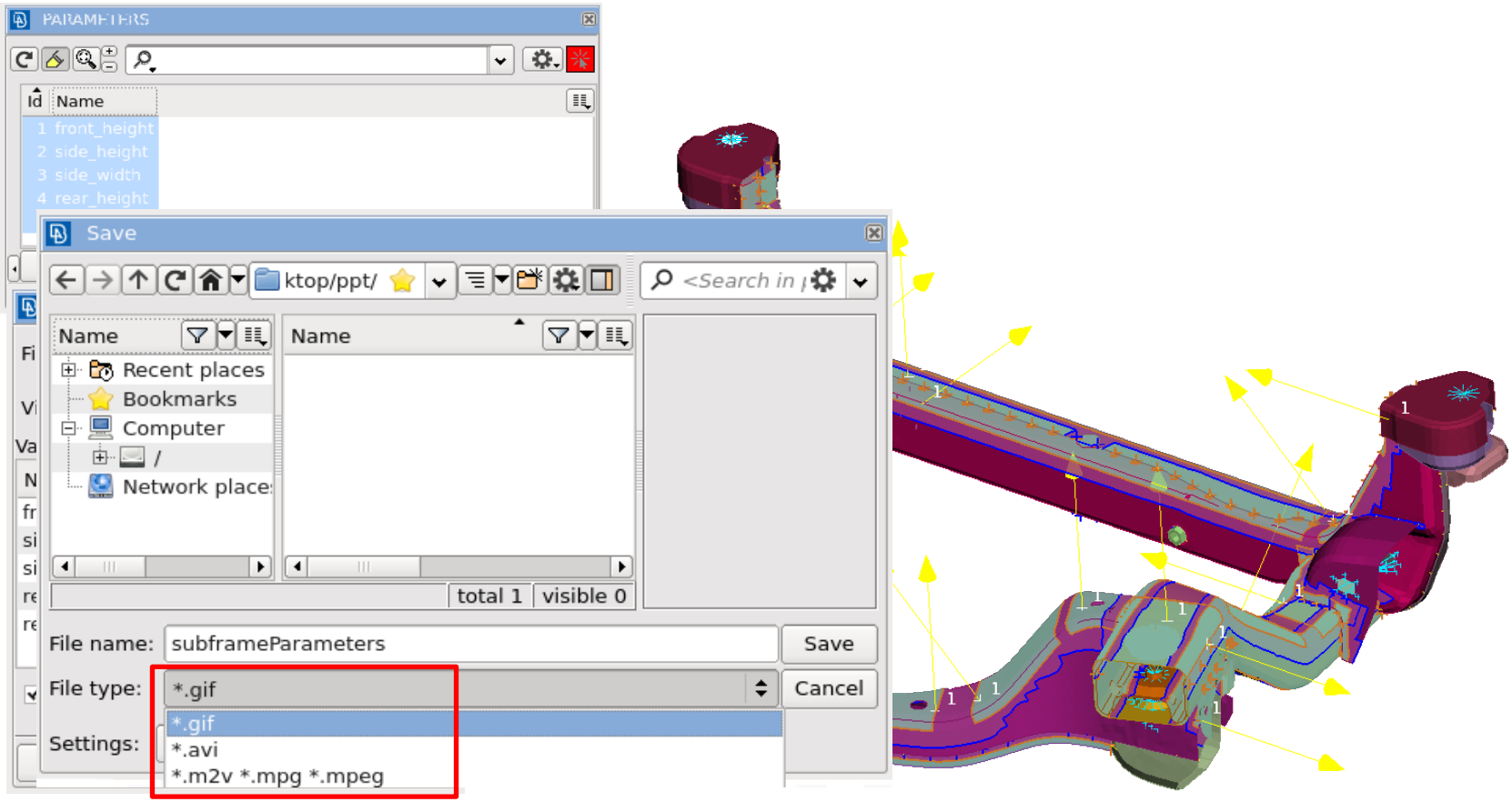

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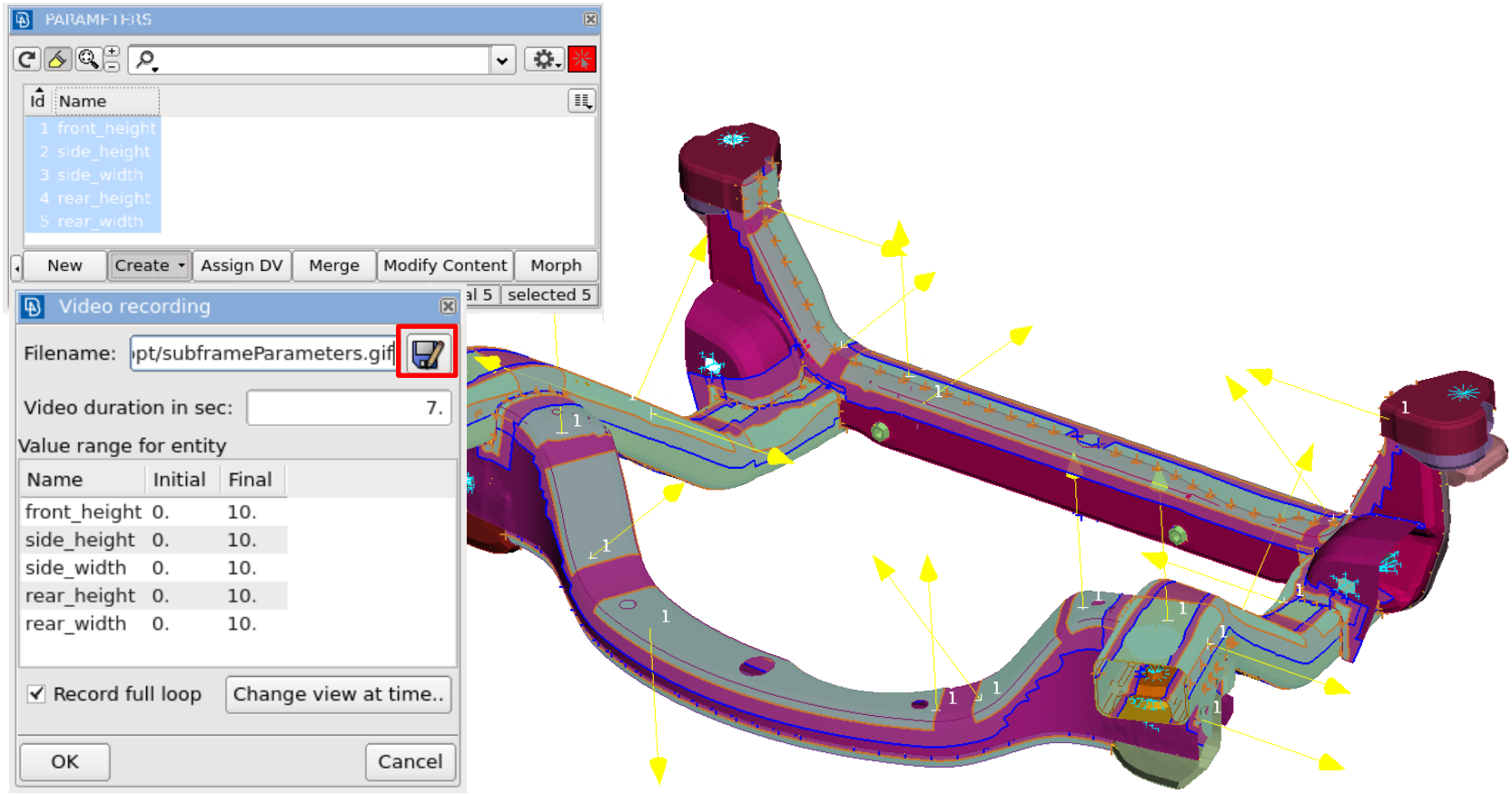

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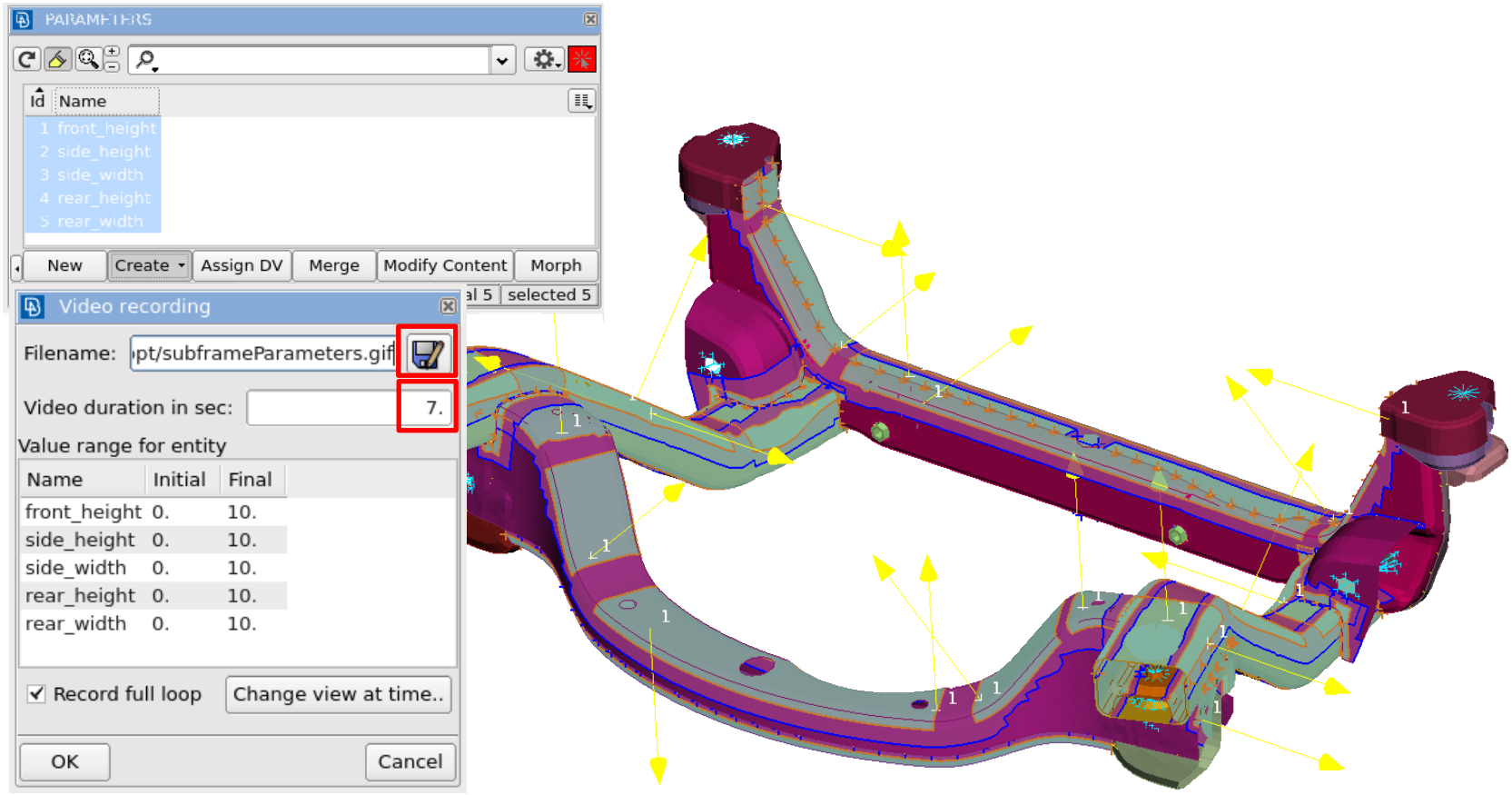

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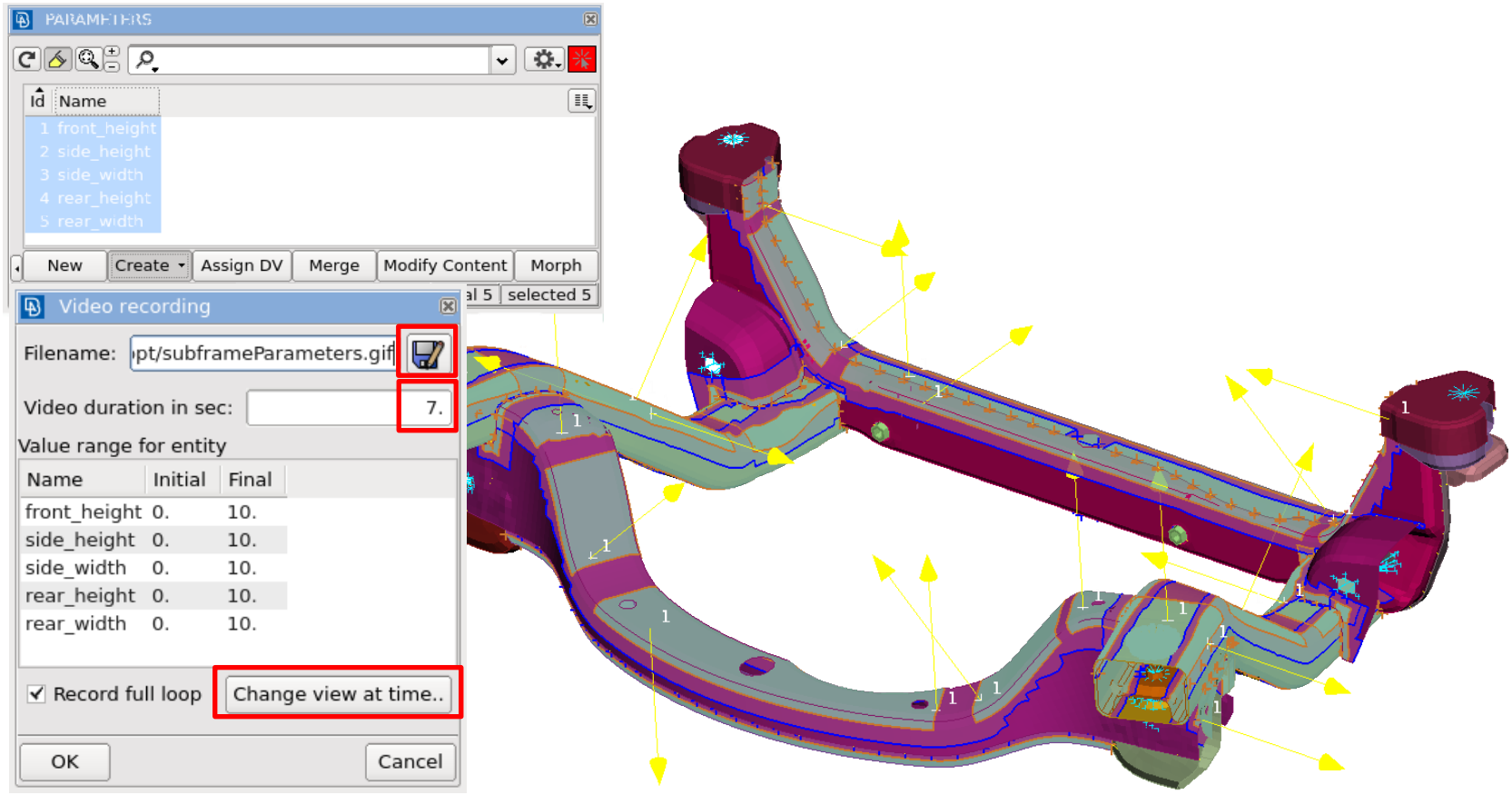

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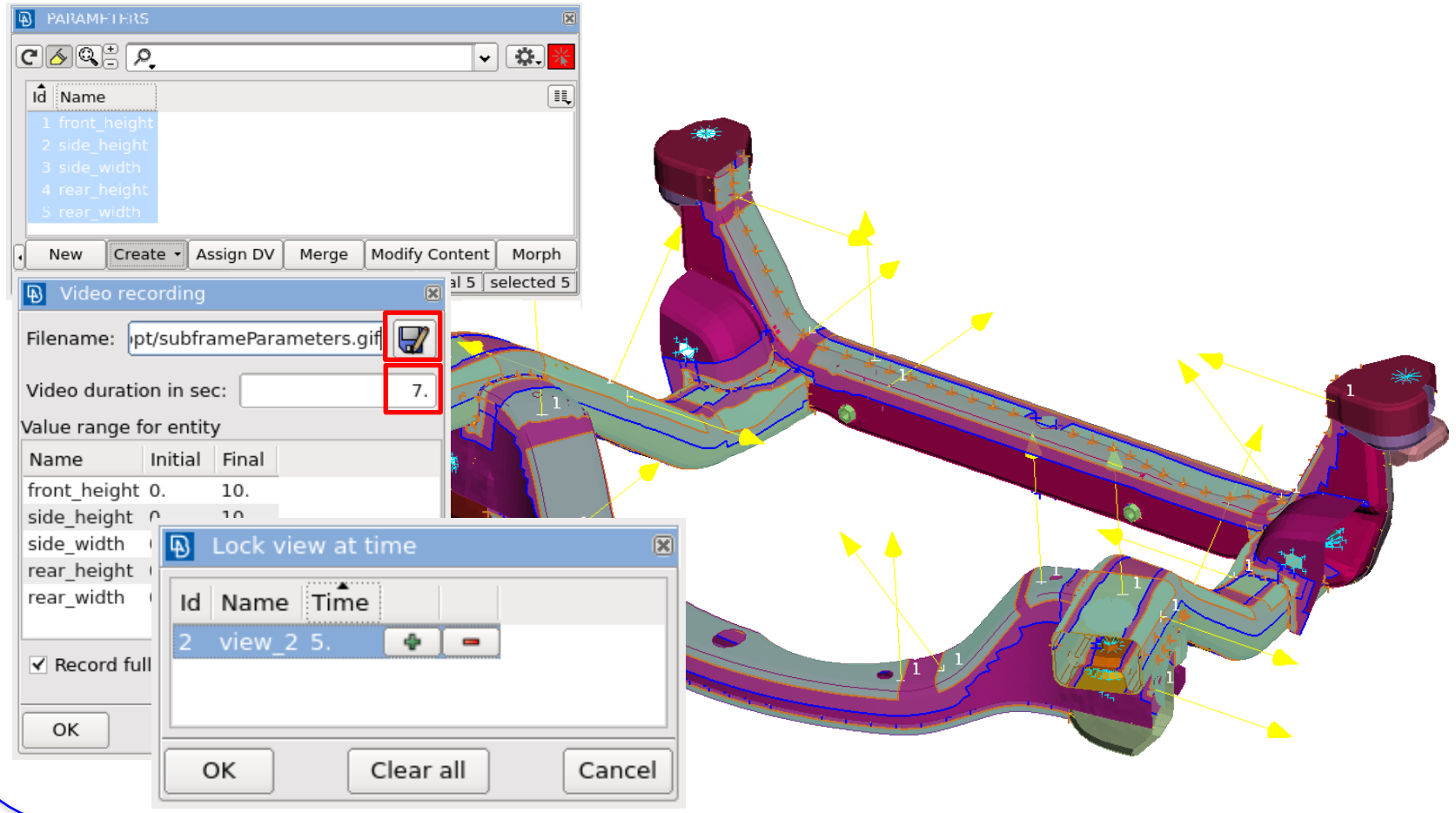
## Video Recording



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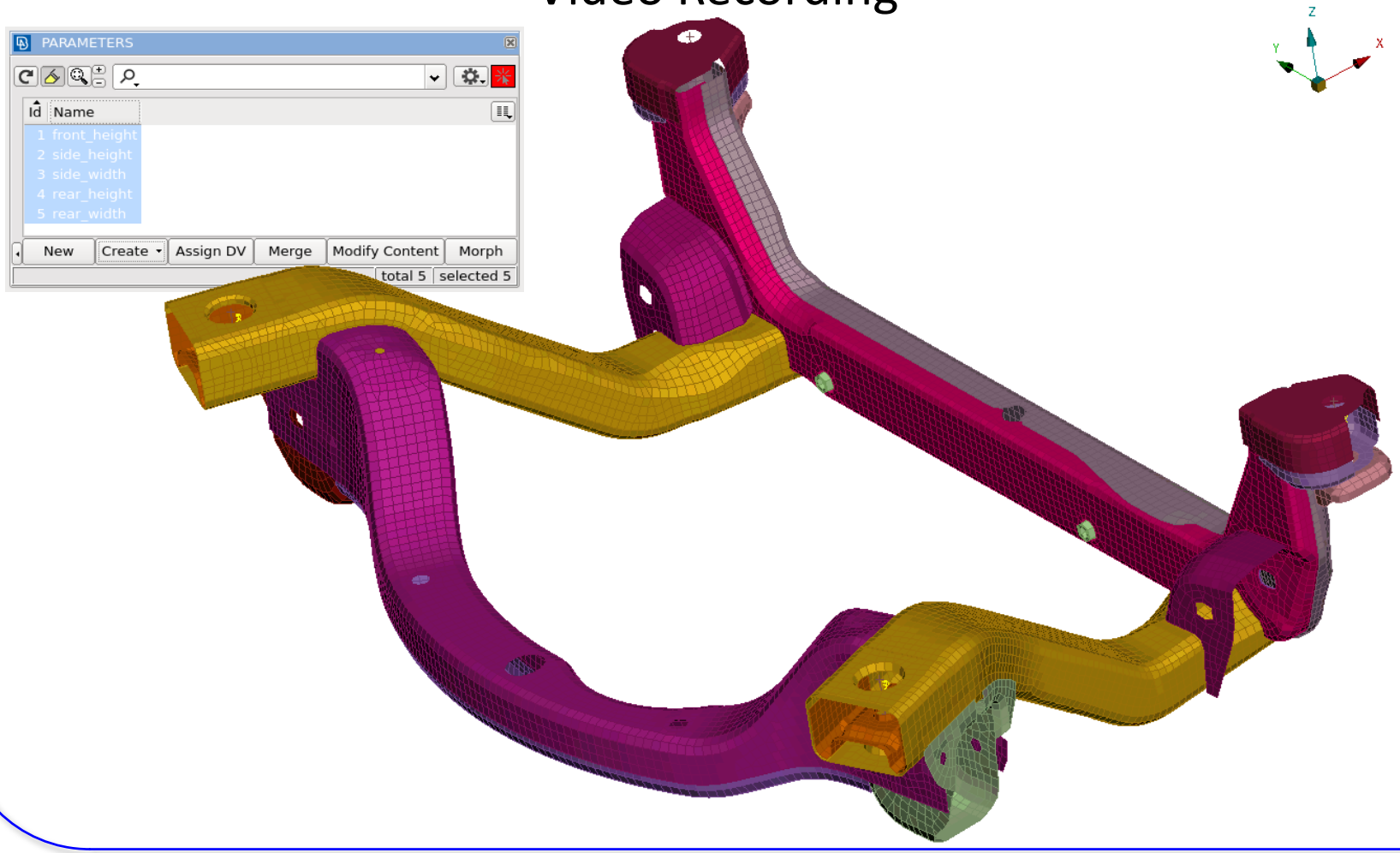
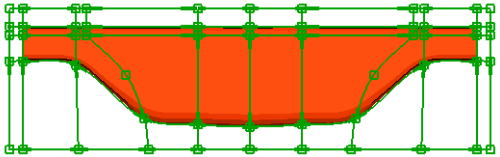


# Record Morphing Actions

## 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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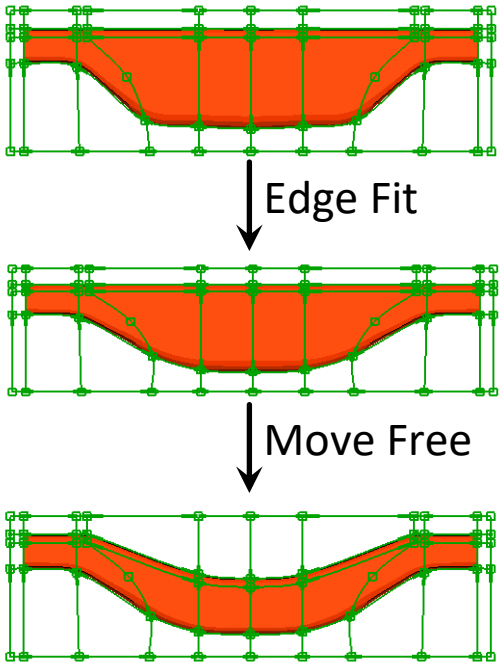


Initial shape – start recording

Deformed shape – stop recording

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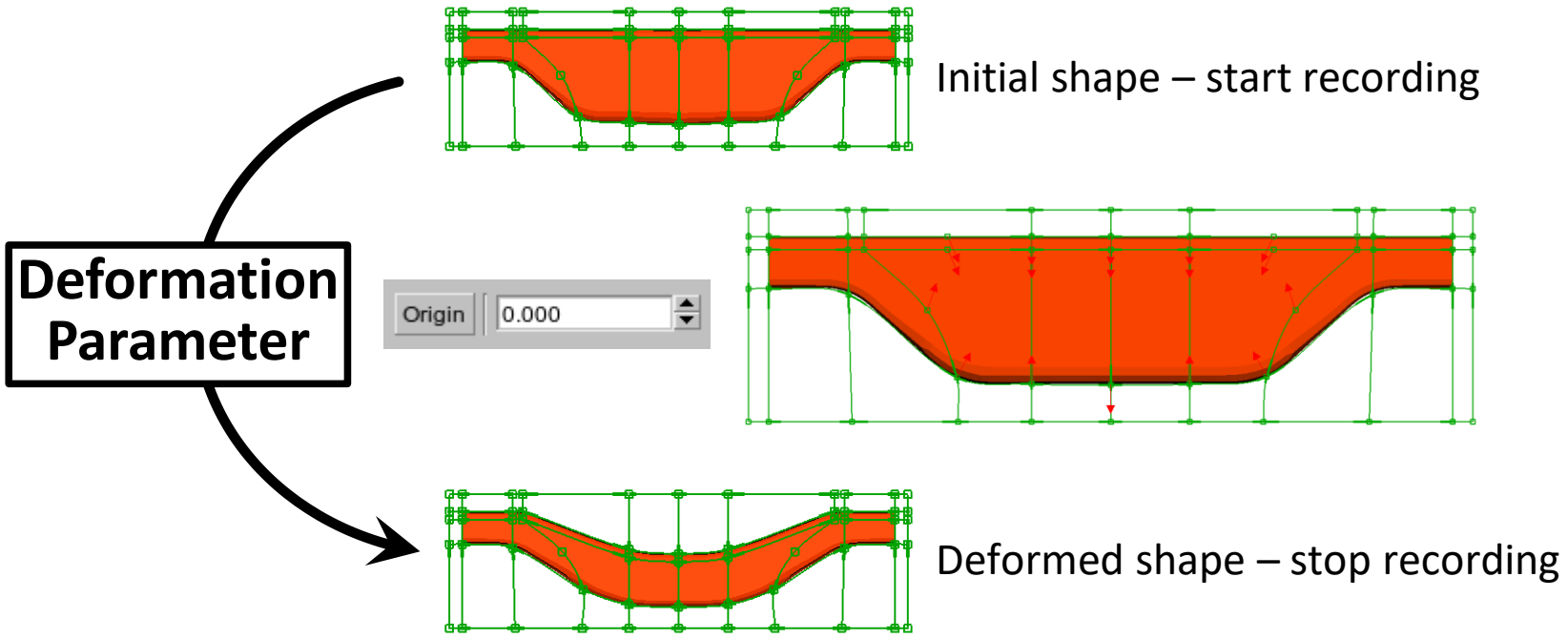

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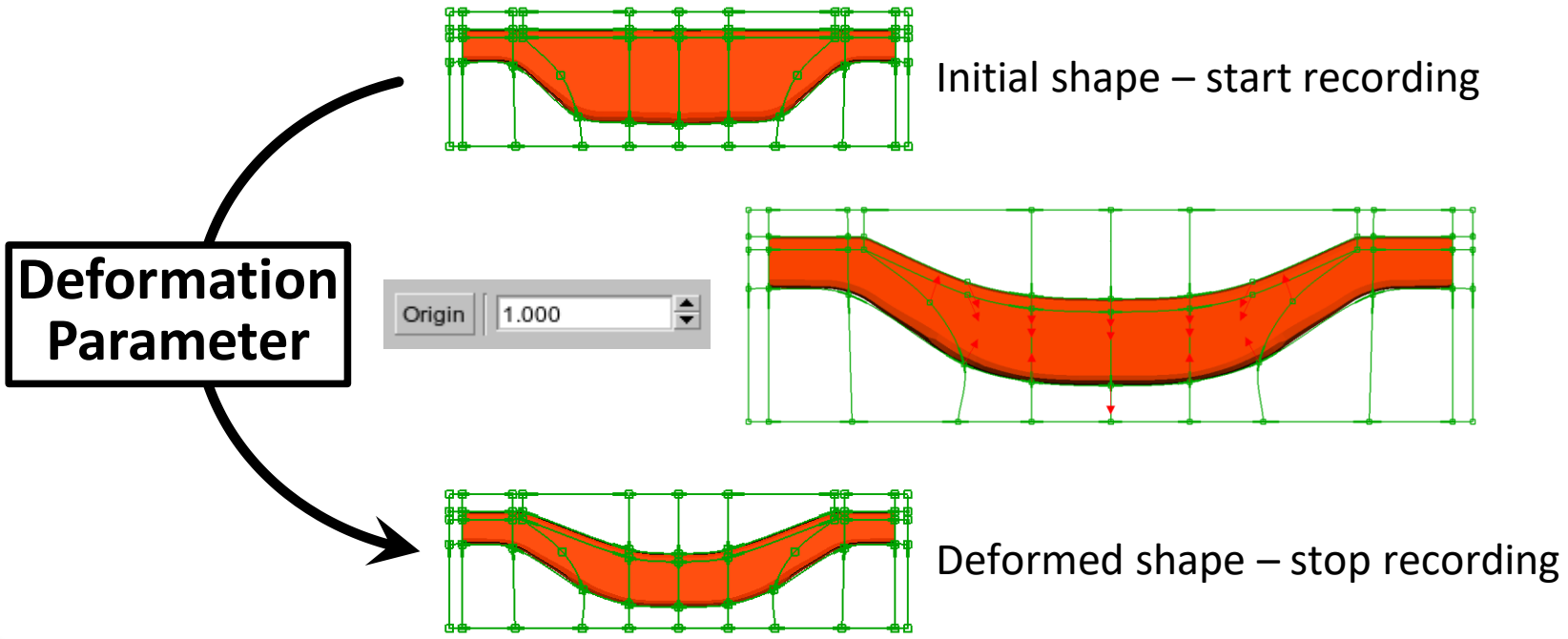
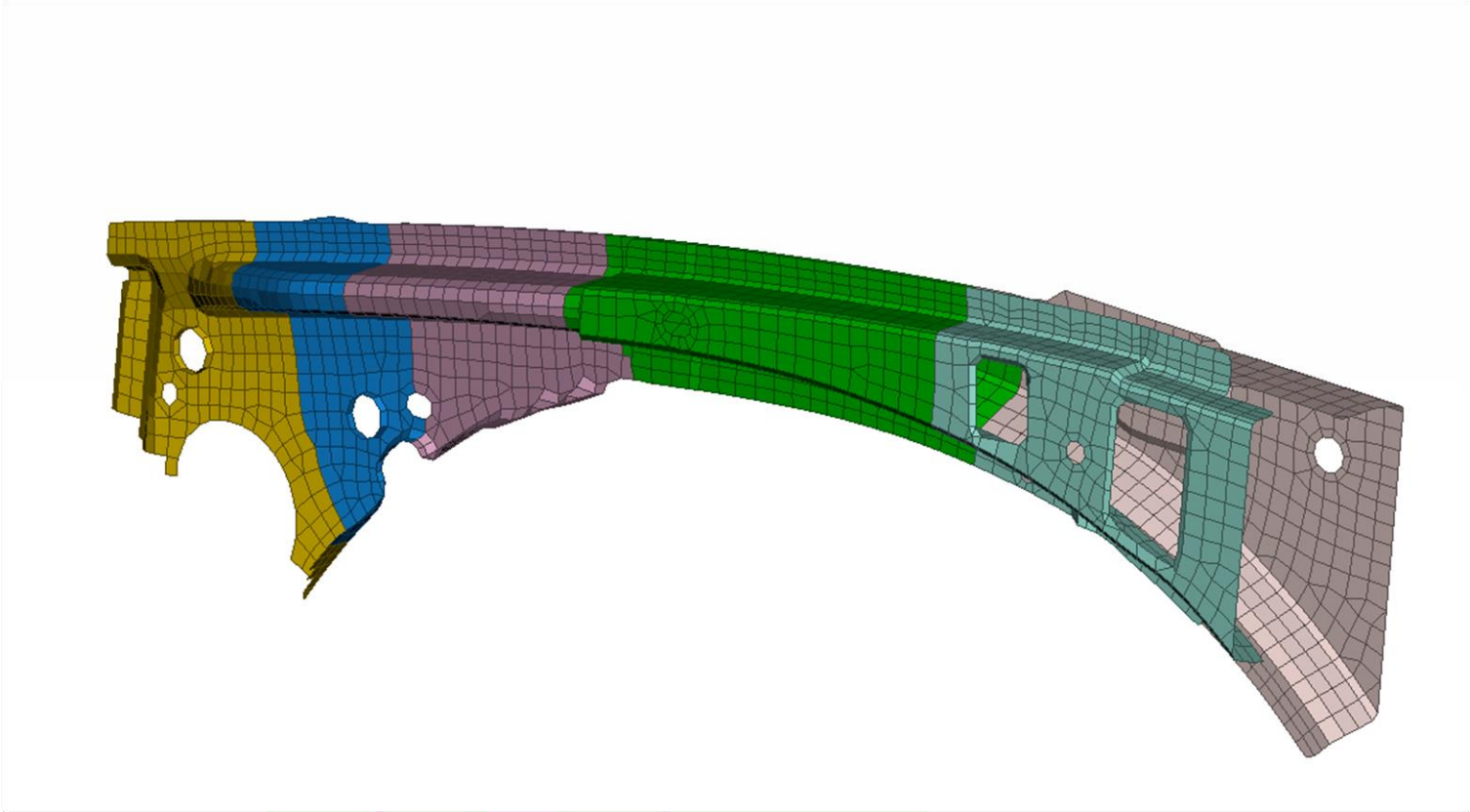


# Taylor Welded Blanks Parameter

## Parameterization and Optimization of Taylor Blanks



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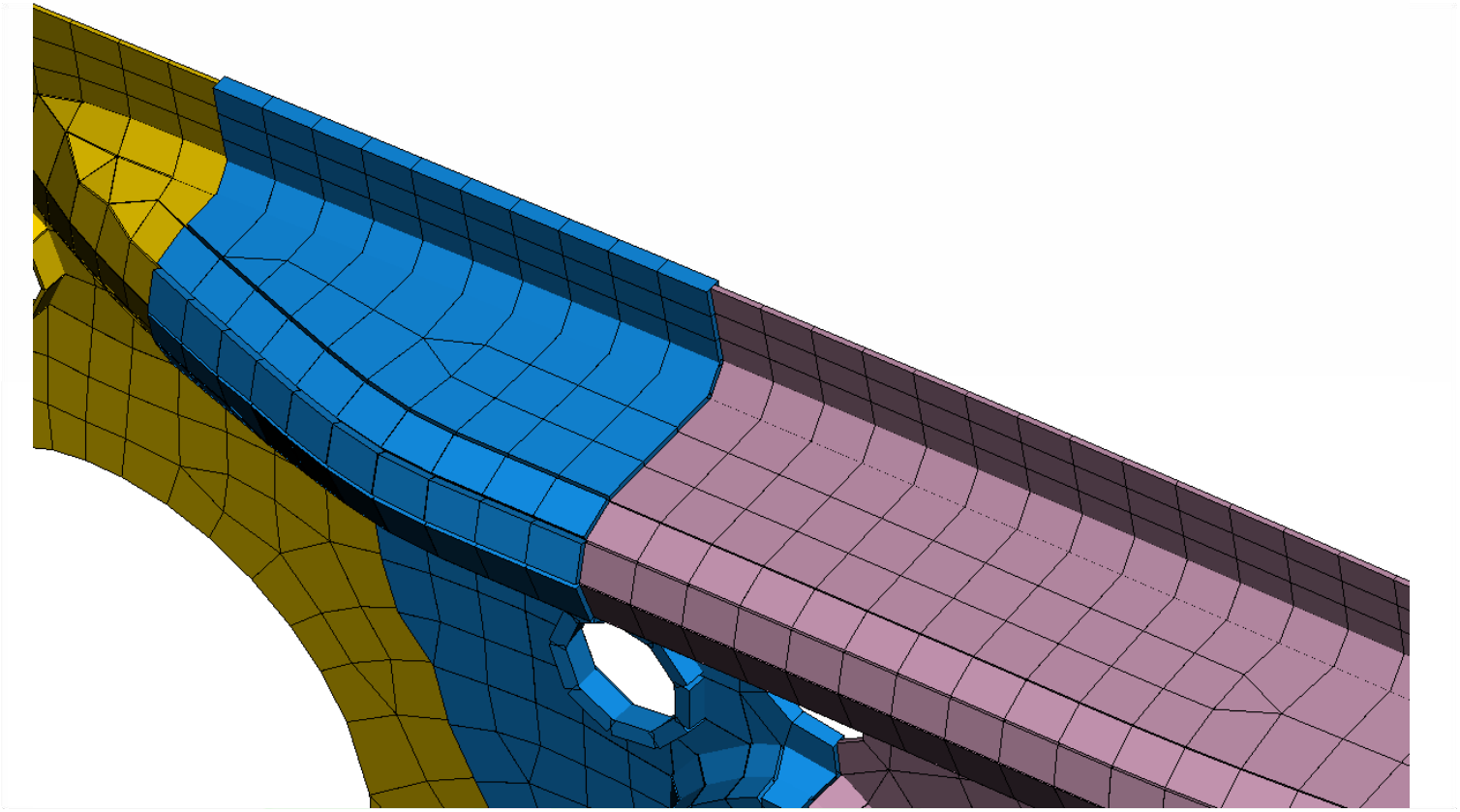
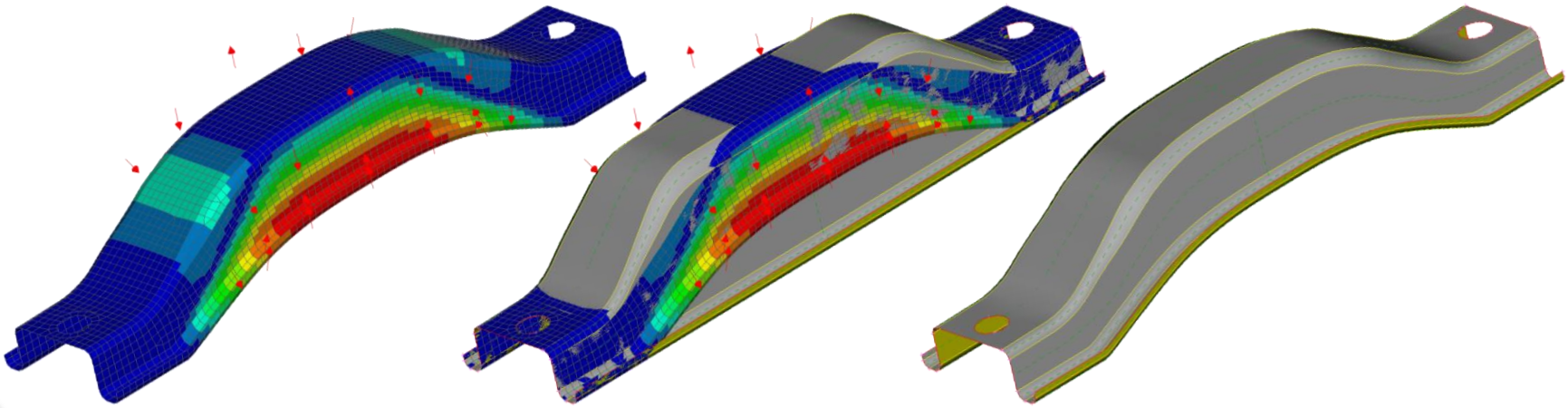


# Mapping of Deformations

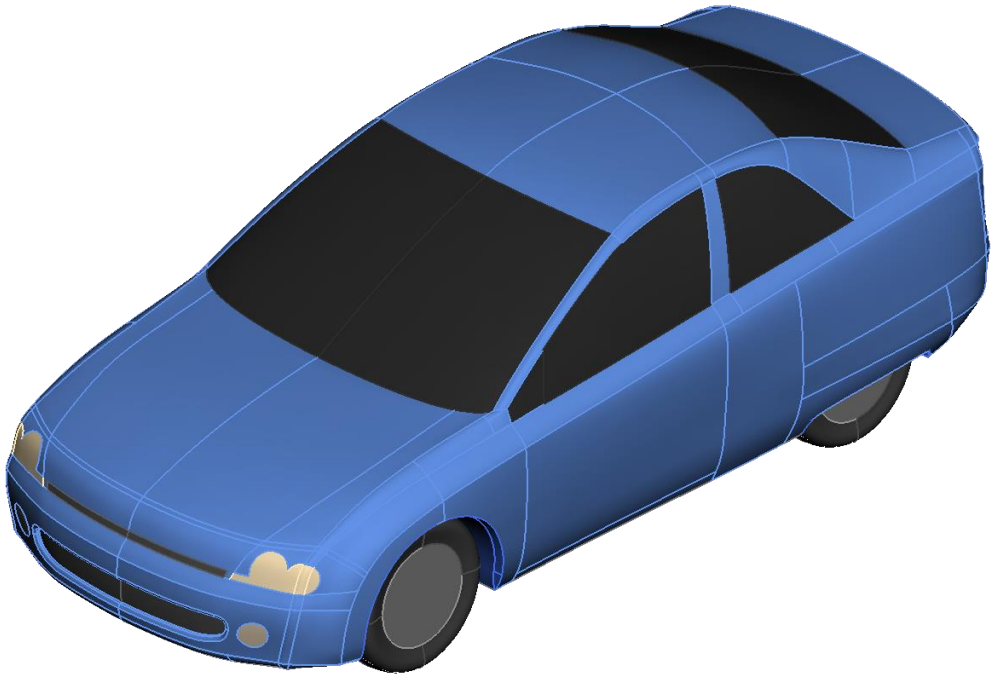
- Morph according existing deformation field from:
  - Deformation Parameter
  - History States
  - DESVAR of Nastran SOL 200
  - Text file
- E.g. Modify geometry according optimized FE-model



# 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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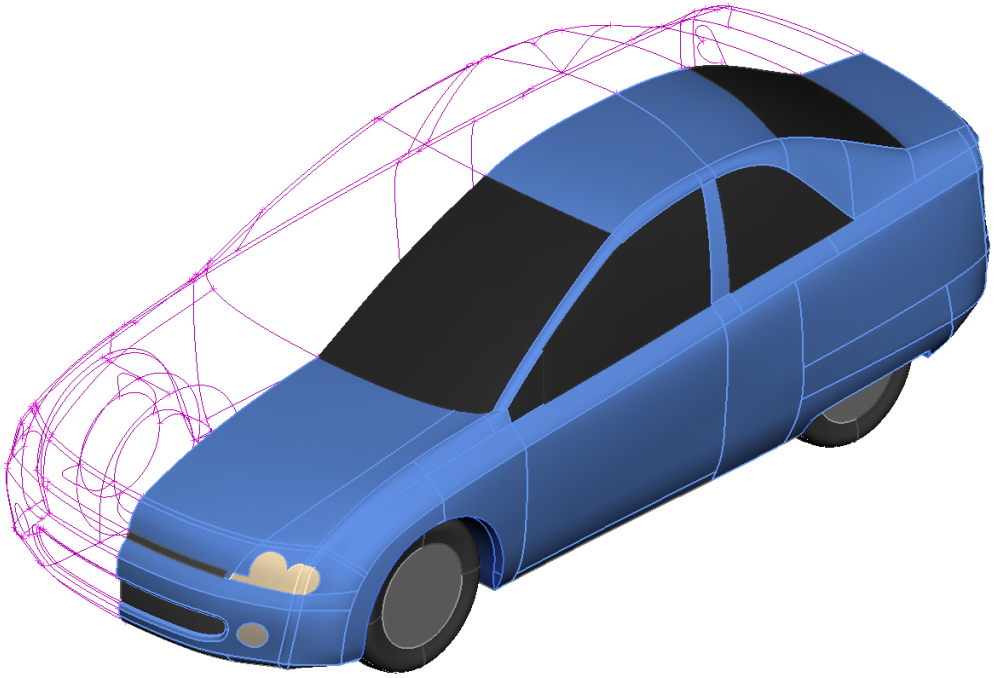
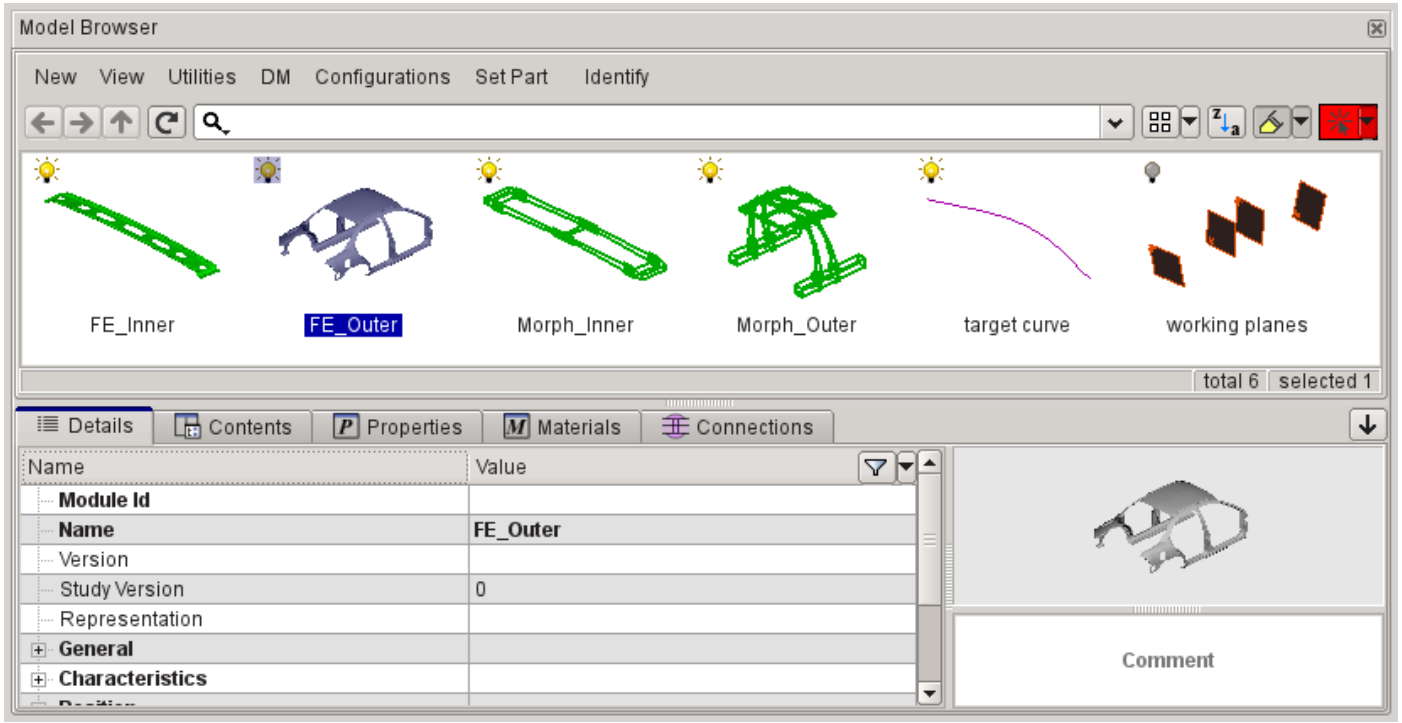


# Functionalities assisting Morphing

## Model Browser

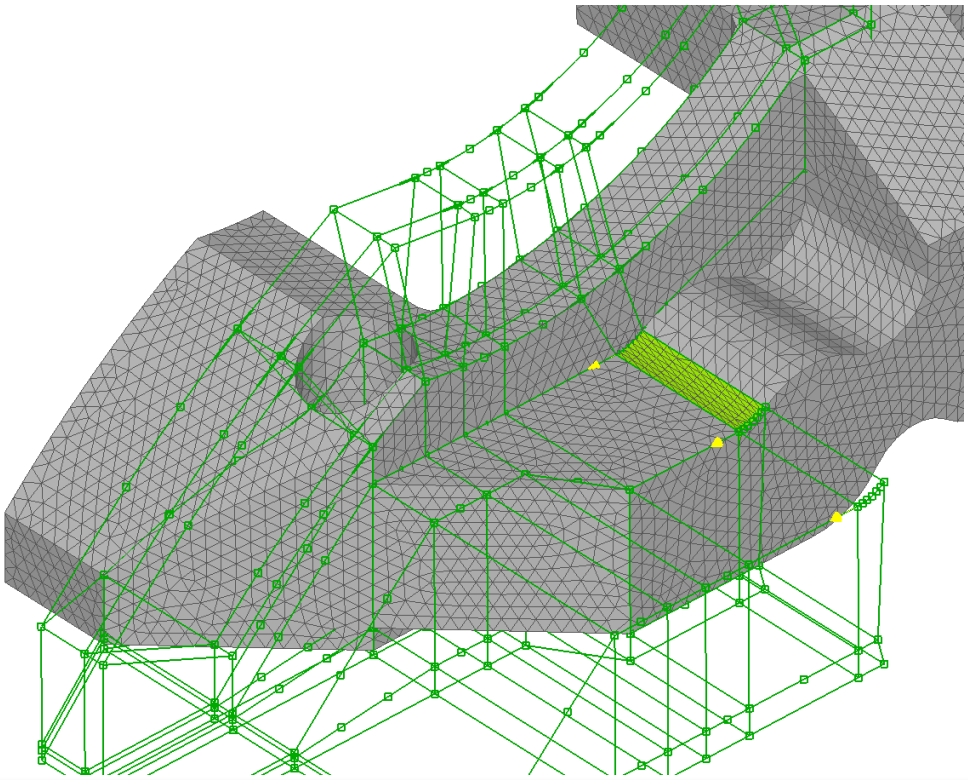
- Useful for Box Morphing (esp. complex configurations)
- To organize morph contents



# Functionalities assisting Morphing

## Reconstruct / Smooth morphed mesh

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



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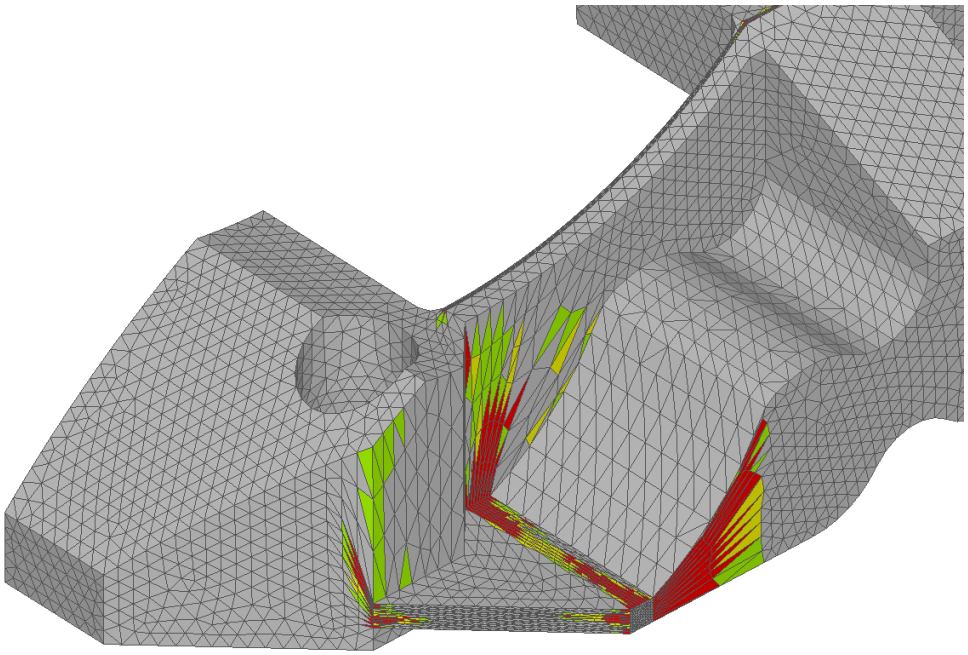

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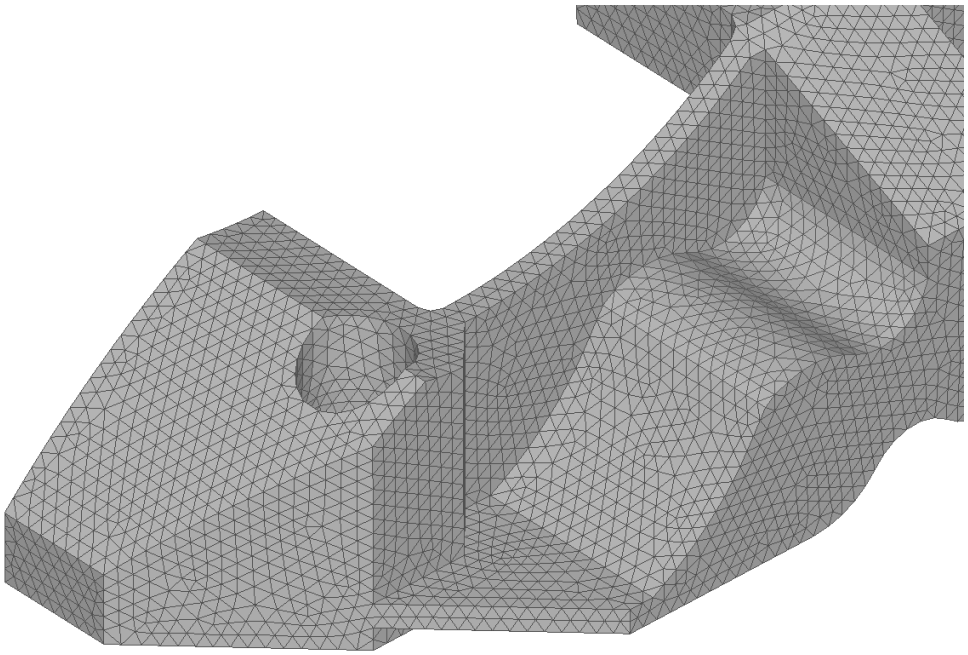
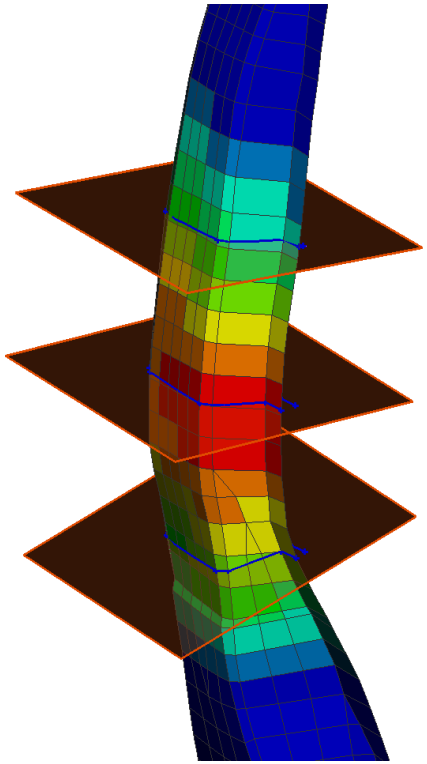


# Functionalities assisting Morphing

## Visualize Morphing Deviations

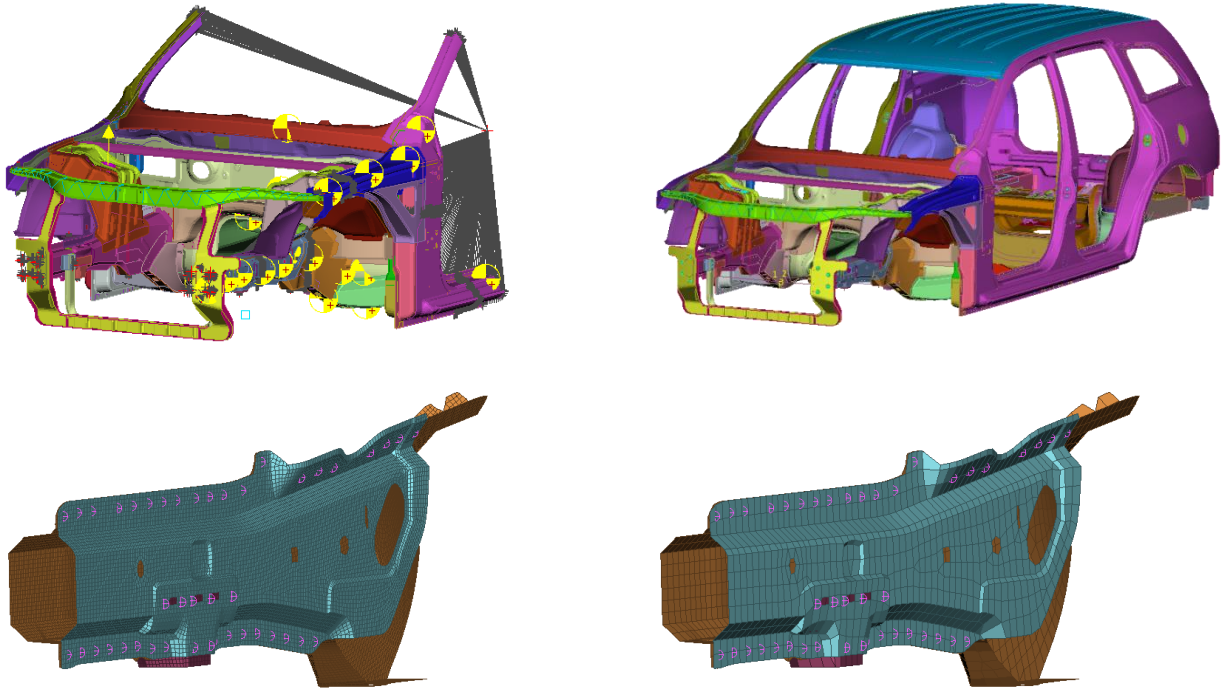
- Suitable for Box and Direct Morphing
- Measurement Tool
- Fringe Plot of deformed shape



# Functionalities assisting Morphing

## DFM Migration

Re-application of DFM parameters on different models



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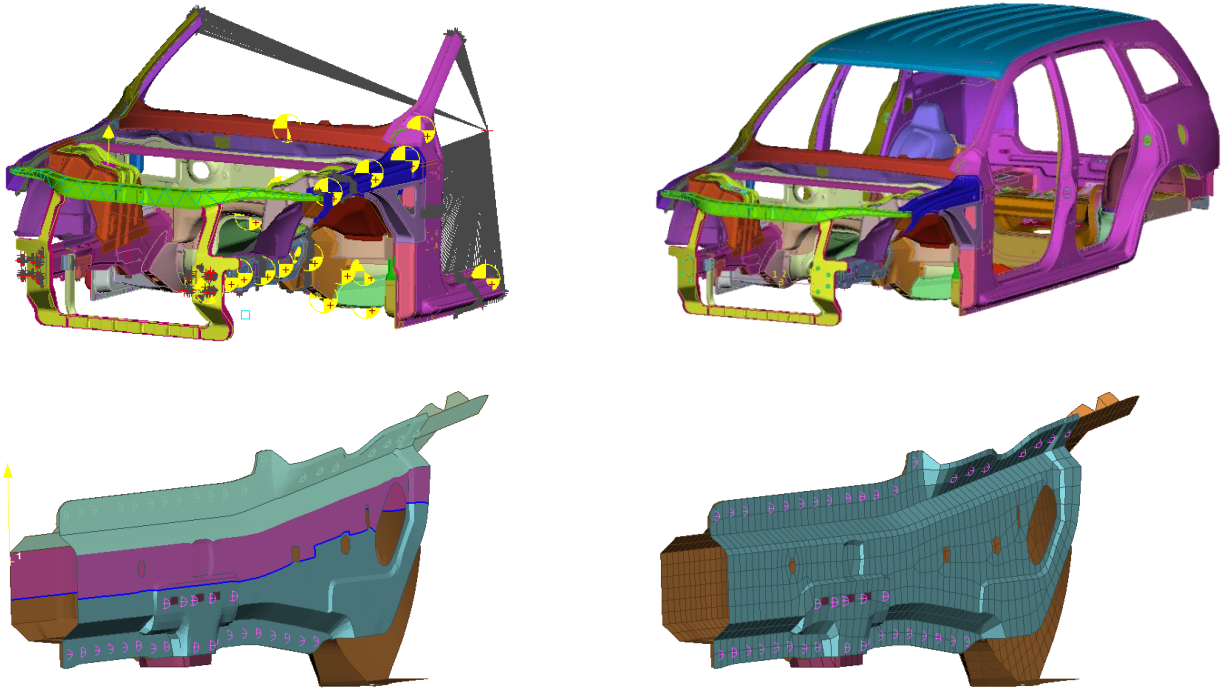

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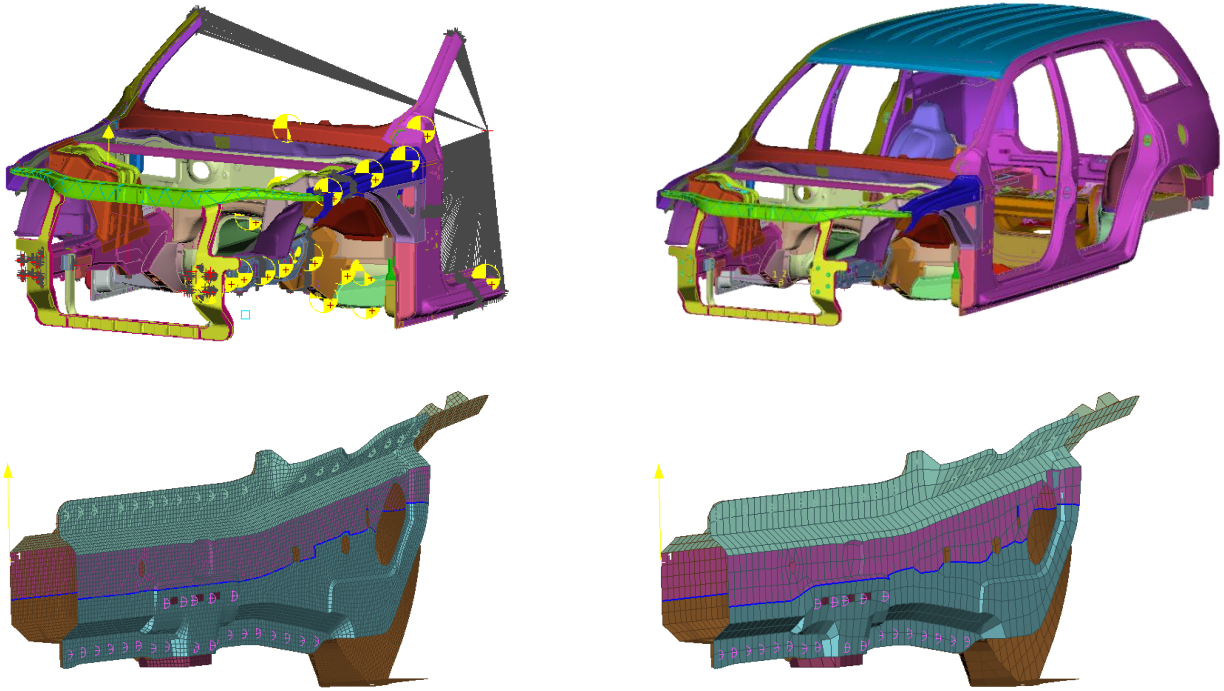
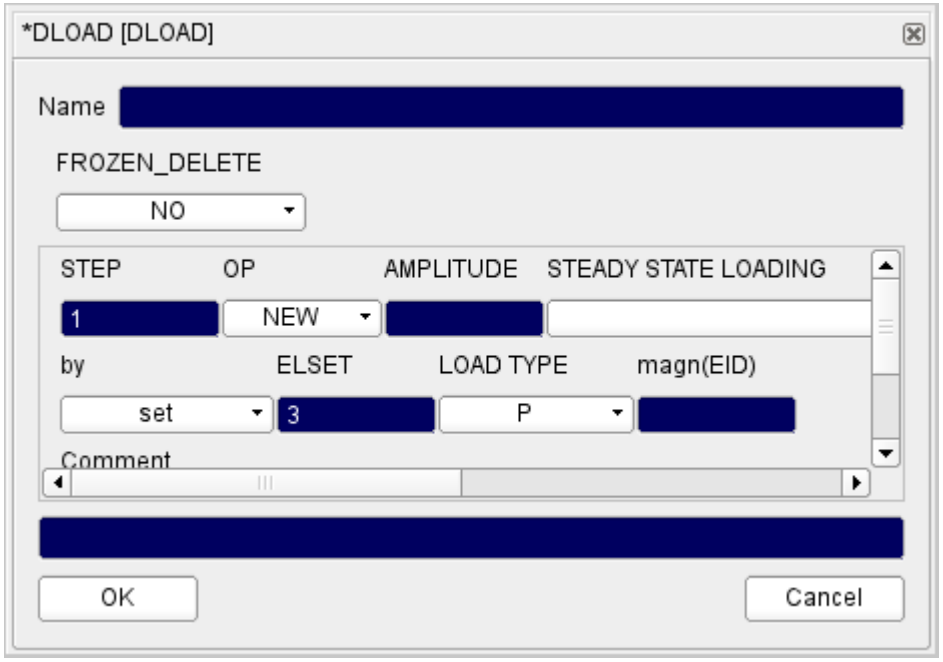


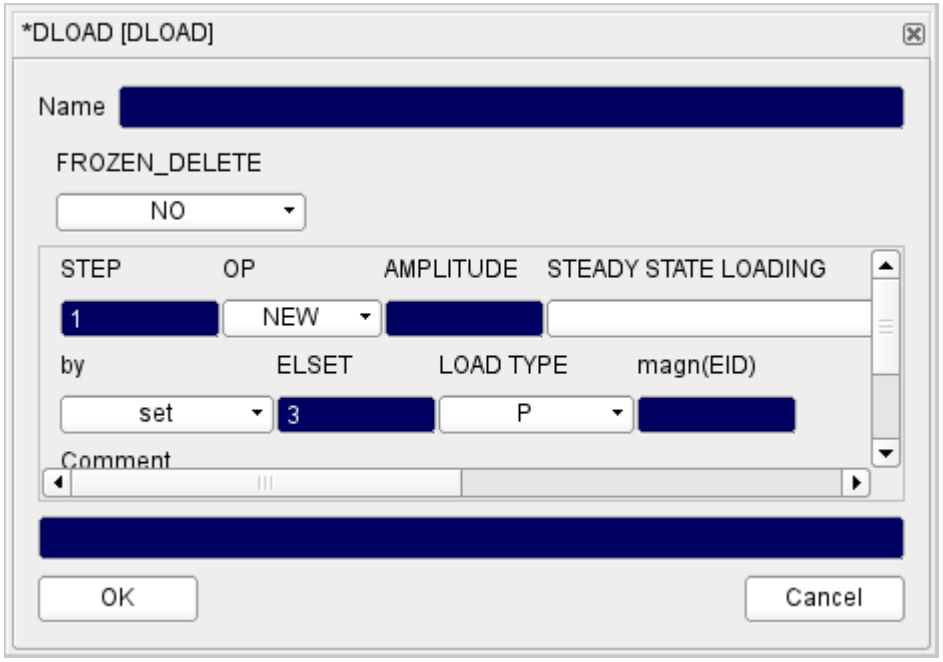
# ANSA Parameter

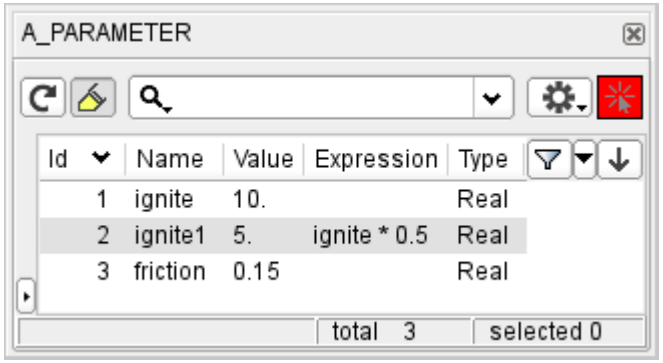
- For parameterization of solver card entries



# ANSA Parameter

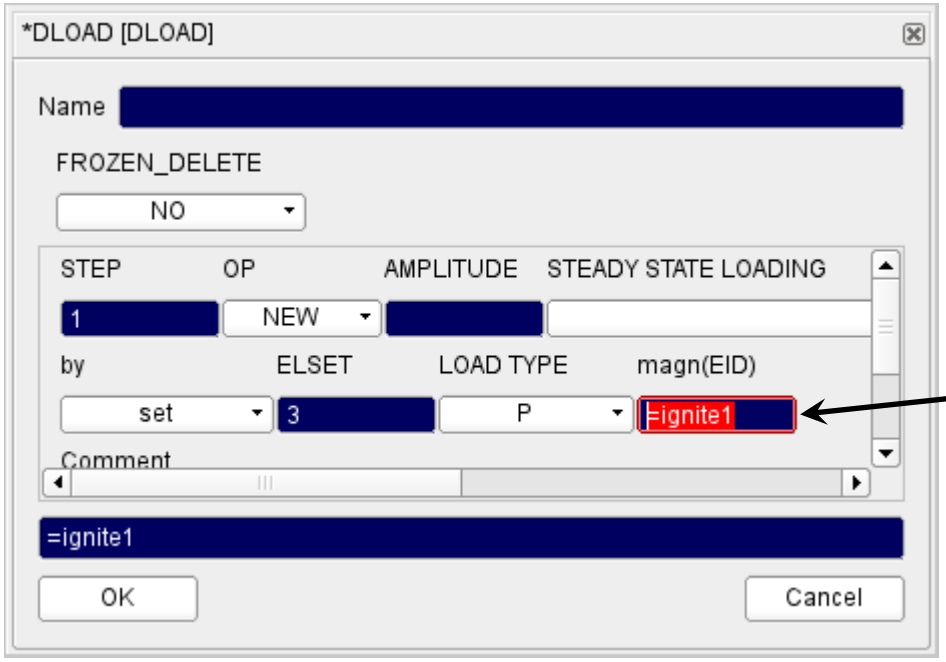
- For parameterization of solver card entries
- Different types; Expressions

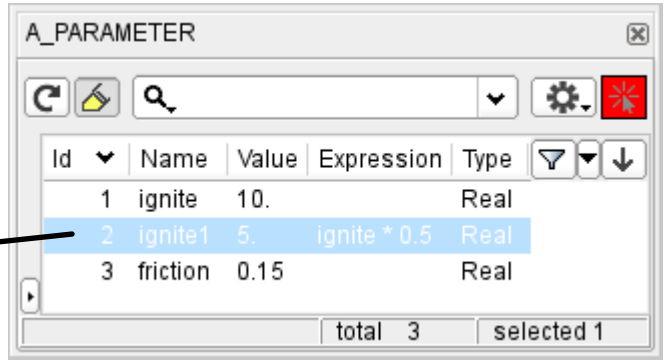


# ANSA Parameter

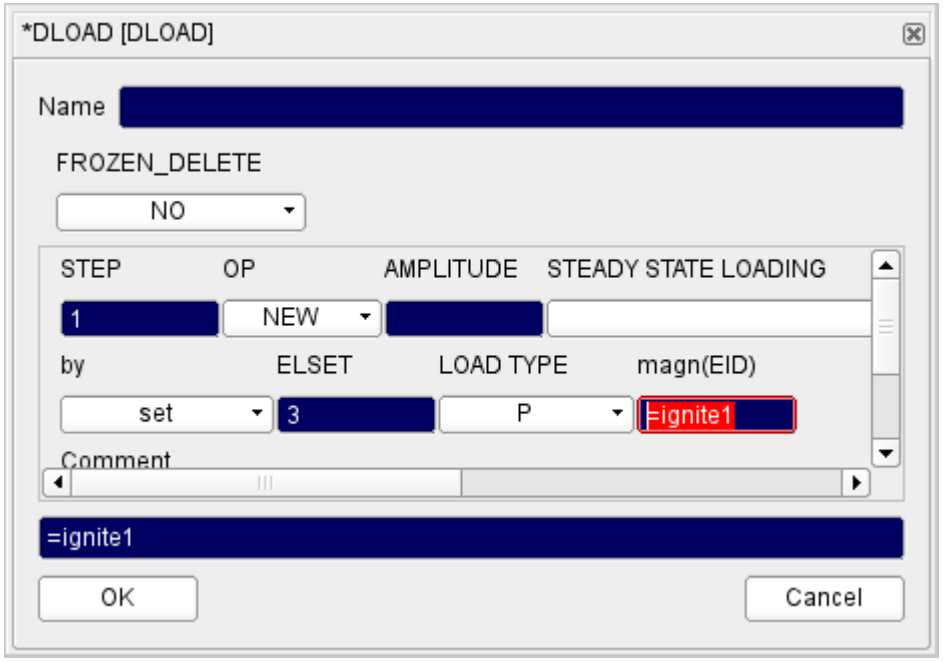
- For parameterization of solver card entries
- Different types; Expressions

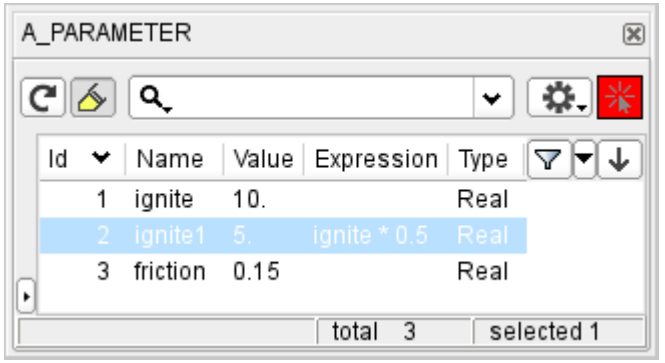


# ANSA Parameter

- For parameterization of solver card entries
- 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>
```

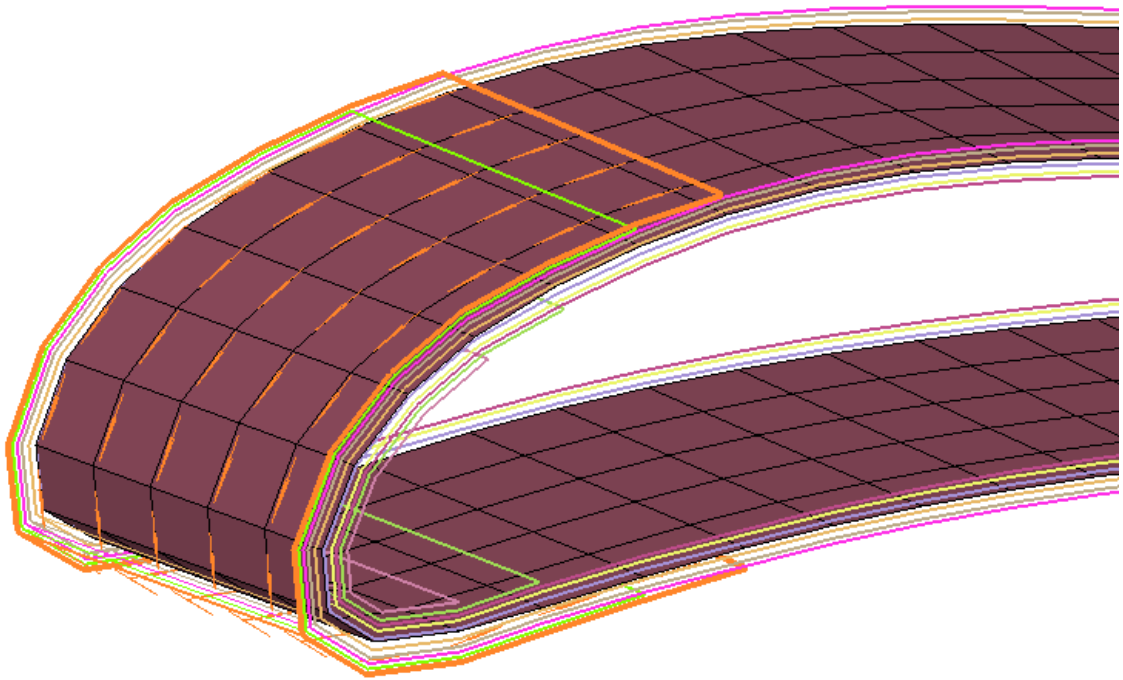
# ANSA Parameter

- 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. | |



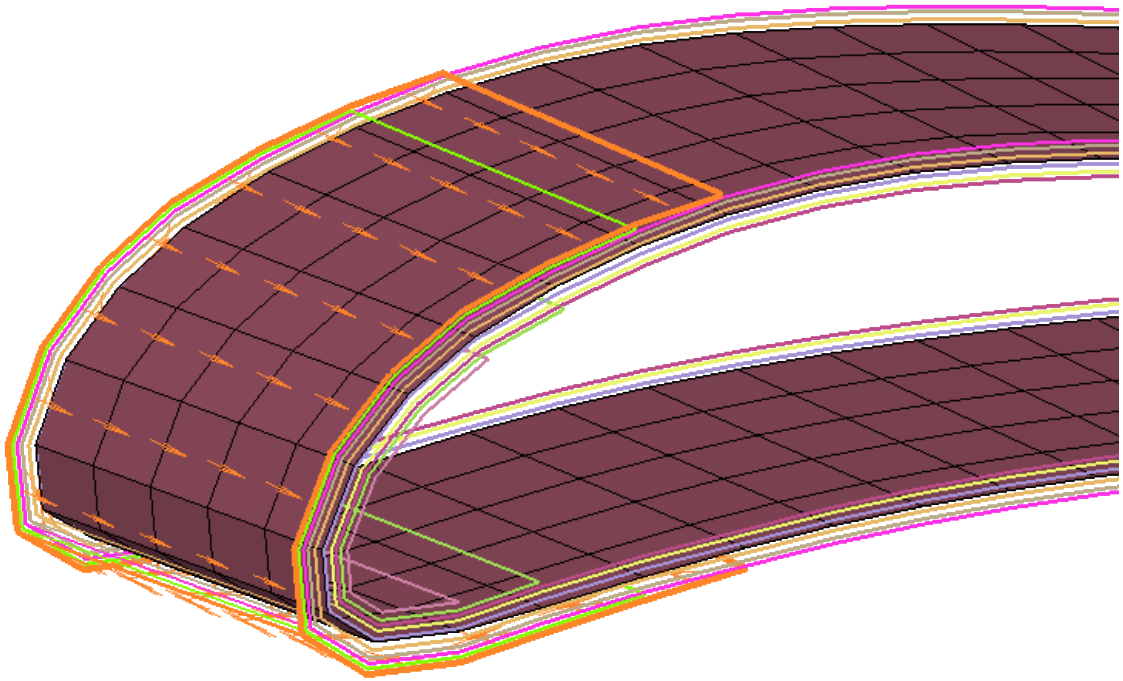
# ANSA Parameter

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

Layers

| PID | Z0 | NSM | S |
|---|---|---|---|
| 1 | | | |

| A/A | Type | T | THETA | ma |
|---|---|---|---|---|
| 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. | |



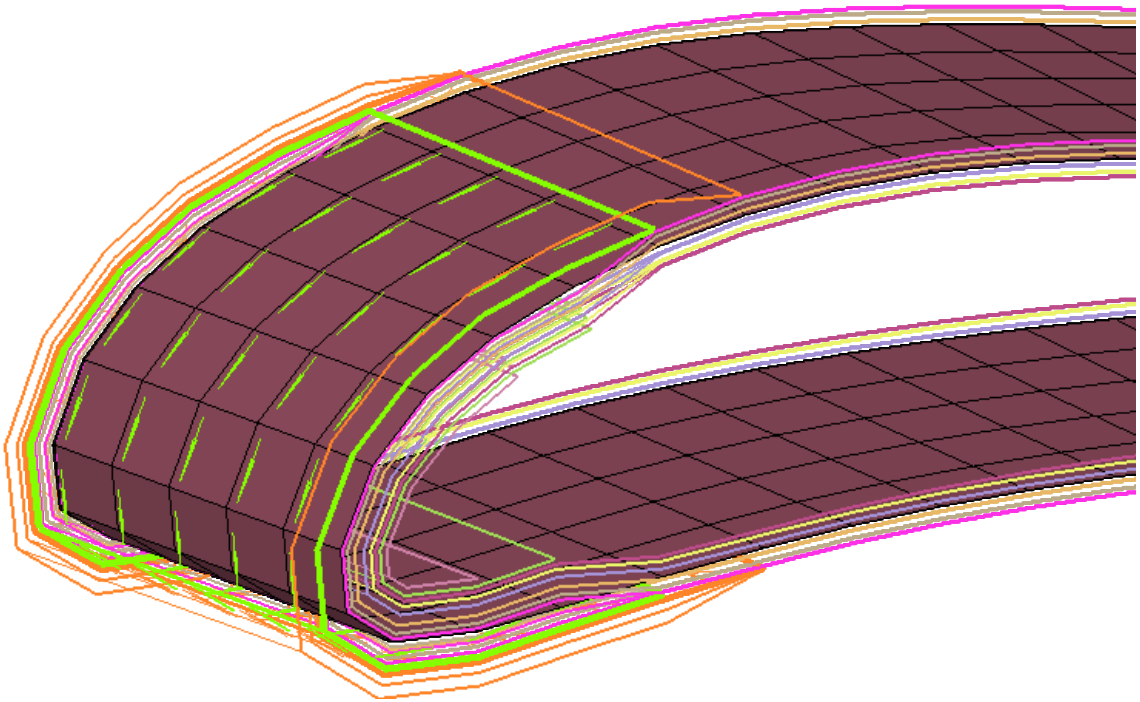
# ANSA Parameter

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

Layers

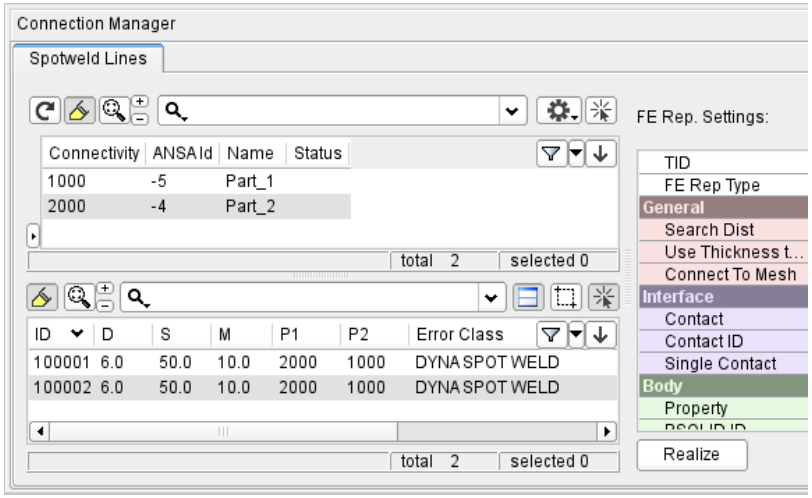
| PID | Z0 | NSM | S |
|---|---|---|---|
| 1 | | | |

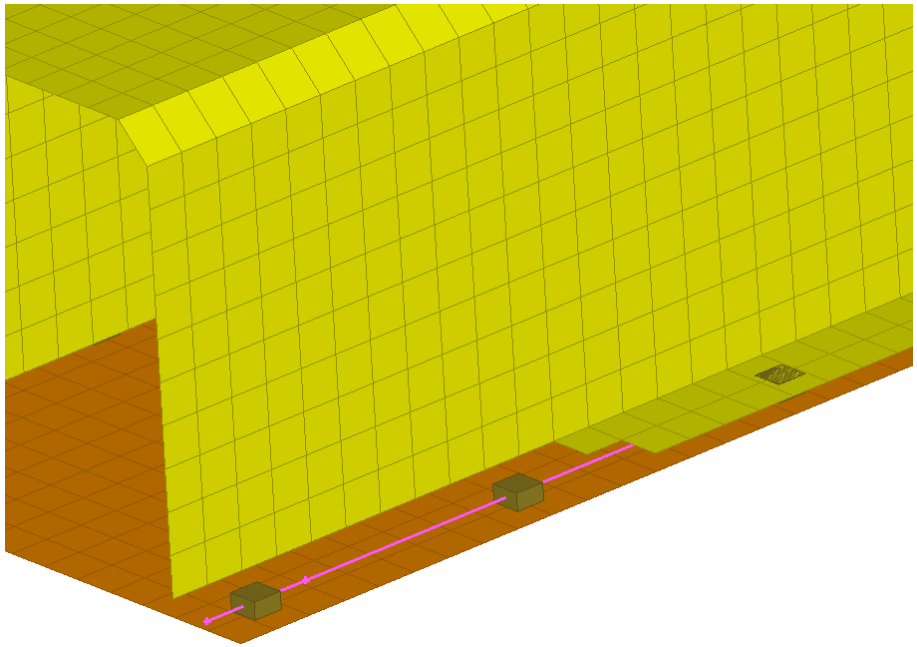
| A/A | Type | T | THETA | ma |
|---|---|---|---|---|
| 1 | Sequence | | | |
| 1 | Layer | 0.2 | 90. | |
| 2 | Layer | 0.1 | -45. | |
| 3 | Layer | 0.1 | 45. | |
| 4 | Layer | 0.2 | 0. | |
| 5 | Layer | 0.2 | 0. | |
| 6 | Layer | 0.1 | 45. | |
| 7 | Layer | 0.1 | -45. | |
| 8 | Layer | 0.2 | 90. | |



# ANSA Parameter

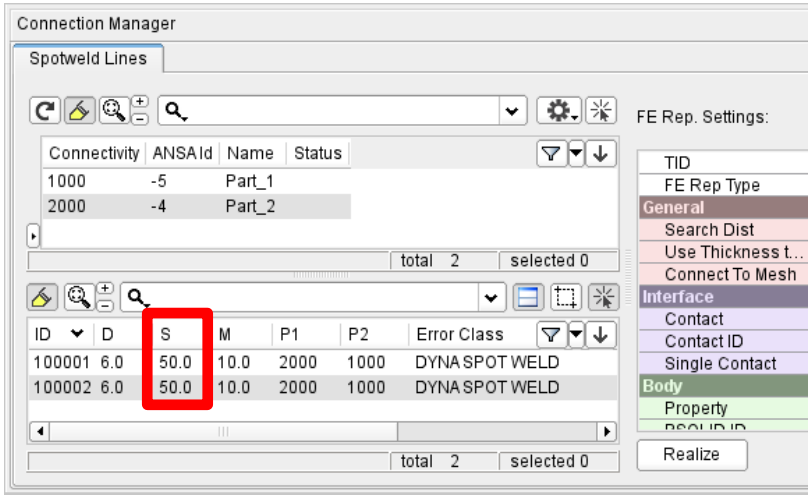
- For parameterization of connection properties, e.g.:

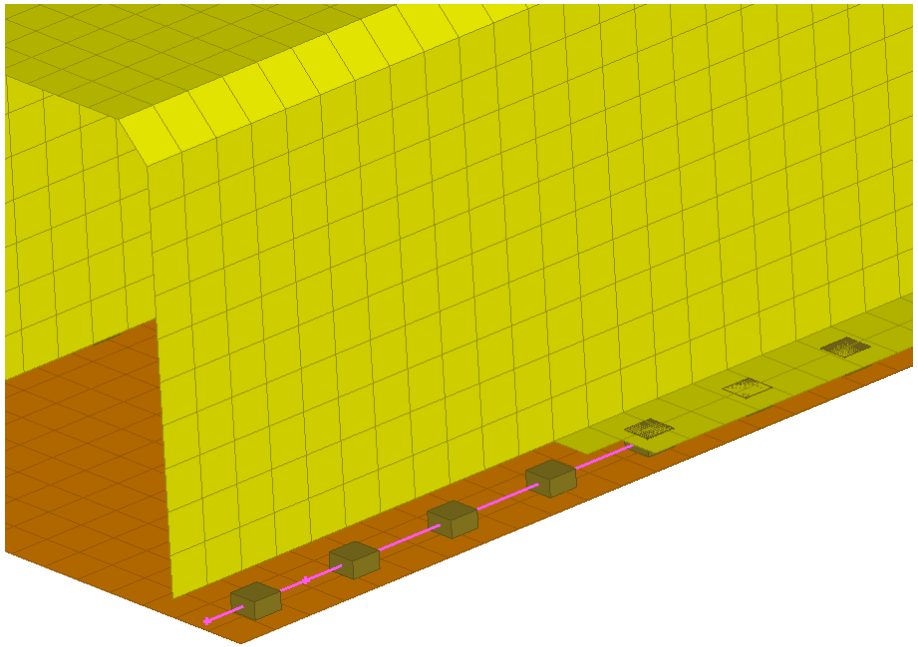


# ANSA Parameter

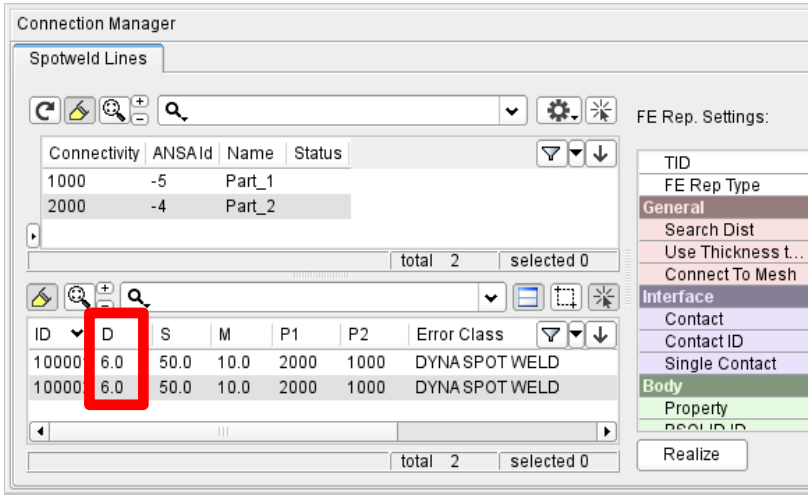
- For parameterization of connection properties, e.g.:
  - distance between weld spots

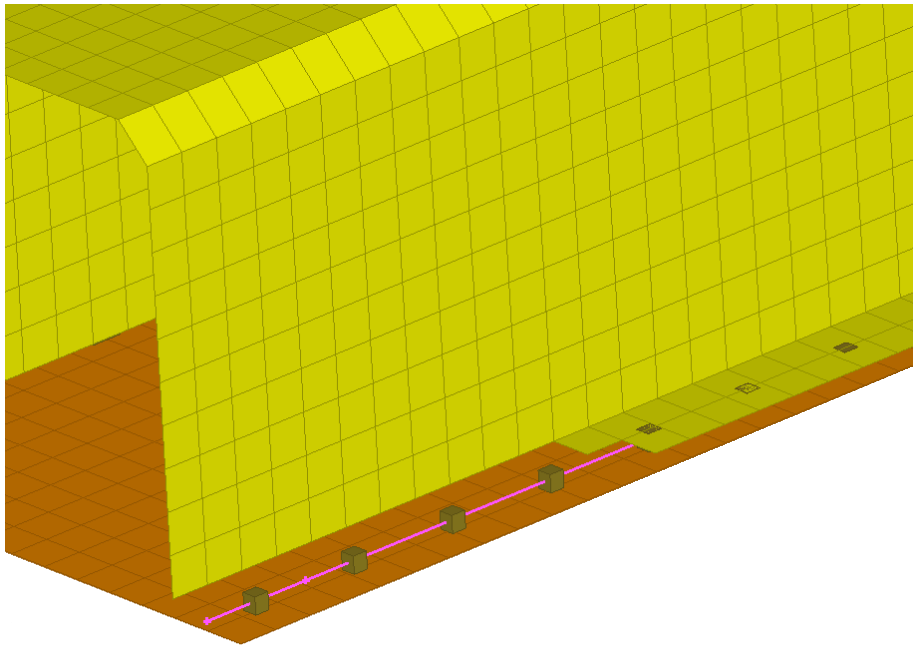


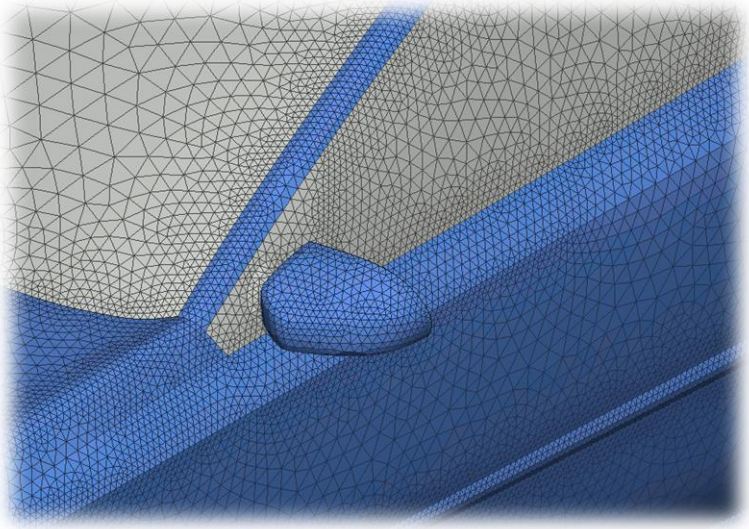
# ANSA Parameter

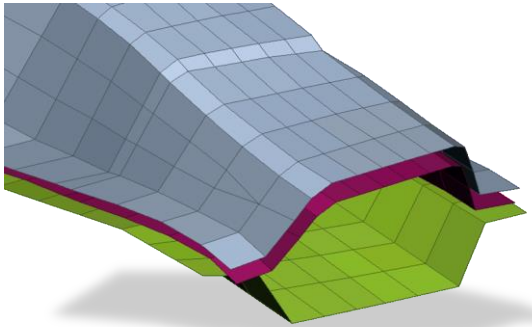
- For parameterization of connection properties, e.g.:
  - distance between weld spots
  - diameter of weld spots

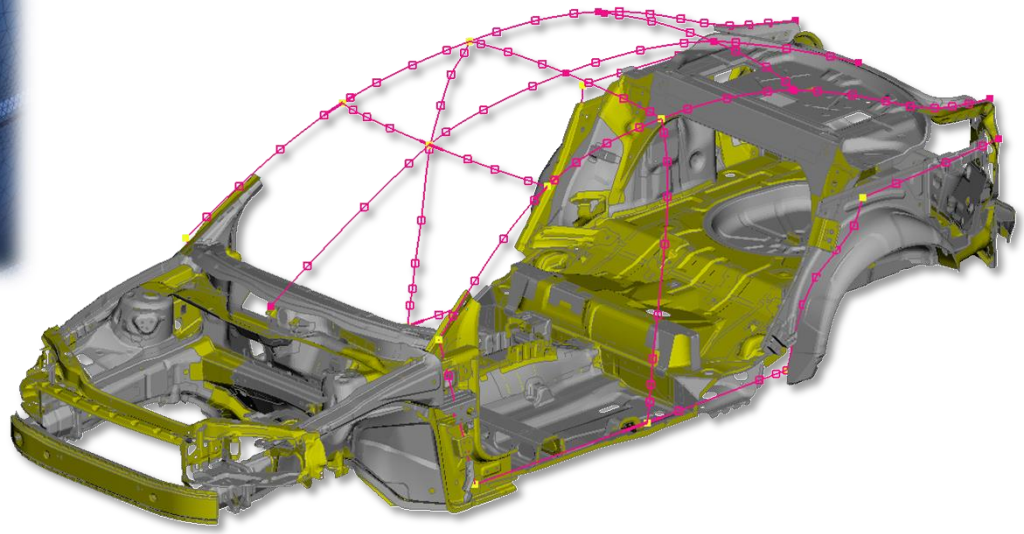


# Ευχαριστώ πολύ







Web: www.beta-cae.com
www.lasso.de
Mail: ansa@lasso.de