Model Parameterization in ANSA
Types of Parameterization

• Shape modification (e.g. position of B-pillar)
  → Morphing
Types of Parameterization

• Shape modification (e.g. position of B-pillar)
  → Morphing

• Modification of solver card entries (e.g. property thickness, used material, connection properties)
  → ANSA Parameter
Types of Parameterization

• Shape modification (e.g. position of B-pillar)
  → Morphing
• Modification of solver card entries (e.g. property thickness, used material, connection properties)
  → ANSA Parameter
• Anything else
  → Scripting
Morphing

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

• Applicable on FE- and Geometry models
• Two main methods:
  – Direct Morphing
  – Using Morphing Boxes
Direct Morphing

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

- Control Entities
- Morphed Entities
- Boundary
- Morphing
Direct Morphing

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

- Origin
- Target
- Morphed Entities
- Boundary
Direct Morphing

Snap FE or geometry edges to single or multiple target curves

- Origin
- Target
- Morphed Entities
- Boundary
- Morphing
Direct Morphing

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

- Origin
- Target
- Morphed Entities
- Boundary
- Morphing
- Reconstruct (optional)
Direct Morphing

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

- Origin
- Target
- Morphed Entities
- Boundary
Direct Morphing

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

- Origin
- Target
- Morphed Entities
- Boundary
- Morphing
Direct Morphing

Fit surfaces – e.g. fit existing FE-mesh to new CAD-geometry

- Original FE-surface (with additional underlying parts)
Direct Morphing

Fit surfaces – e.g. fit existing FE-mesh to new CAD-geometry

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

Fit surfaces – e.g. fit existing FE-mesh to new CAD-geometry

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

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

• Original cross section
Direct Morphing

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

- Original cross section
- Target cross section
Direct Morphing

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

- Original cross section
- Target cross section
- Morphing
Direct Morphing
Generation & modification of beads and embosses

Triangular-shape
Box-shape

Trapezoidal-shape
Ellipse-shape
Direct Morphing
Generation & modification of beads and embosses
Direct Morphing
Generation & modification of beads and embosses

Curves
Direct Morphing
Generation & modification of beads and embosses

Curves
↓
Depress Parameter
Direct Morphing
Generation & modification of beads and embosses

Curves
↓
Depress Parameter
↓
Depression
Direct Morphing
Generation & modification of beads and embosses

Curves
↓ Depress Parameter
↓ Depression
↓ Reconstruct
Direct Morphing
Generation & modification of beads and embosses

Curves
\[\rightarrow\]
Depress Parameter
\[\rightarrow\]
Depression
\[\rightarrow\]
Reconstruct
Direct Morphing
Generation & modification of beads and embosses

Curves
↓
Depress Parameter
↓
Depression
↓
Reconstruct
↓
Auto-created morph boxes and parameters
Direct Morphing
Generation & modification of beads and embosses

Curves
↓
Depress Parameter
↓
Depression
↓
Reconstruct
↓
Auto-created morph boxes and parameters
Box Morphing
Types of boxes

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

- 2D (specific thickness)
- 1D (specific diameter)
Box Morphing
Approach 1

- Multiple boxes, following the shape of the structure
- Moving / sliding of control points reshapes the model
- **Rough modification** of model shape
Box Morphing
Approach 2

• Single box, split into many whose edges fit on feature lines
• Surrounding boxes as buffer zones
• Precise modification of model shape
Box Morphing
Approach 2

• Single box, split into many whose edges fit on feature lines
• Surrounding boxes as buffer zones
• Precise modification of model shape
Box Morphing
Approach 3

• Box in Box
• Separate groups of boxes handle different features
• **Local and global modifications**
Box Morphing

Creation of Boxes
Box Morphing

Creation of Boxes

• Around Entities
Box Morphing
Creation of Boxes

- Around Entities
- Buffer Zones
Box Morphing
Creation of Boxes

- Around Entities
- Buffer Zones
- Split + Fit (to edges or surfaces)
Box Morphing
Creation of Boxes

- Around Entities
- Buffer Zones
- Split + Fit (to edges or surfaces)
- Sweep / Glide
Box Morphing
Creation of Boxes

- Around Entities
- Buffer Zones
- Split + Fit (to edges or surfaces)
- Sweep / Glide
- Adapt
- etc.
Box Morphing
Linked Morphing Boxes

- Taking advantage of model symmetry
- Link according symmetry-/mirror plane, rotation axis or translation vector
Box Morphing
Modification of Boxes

- Move (Translate, Rotate)
- Slide / Extend
Box Morphing
Modification of Boxes

- Move (Translate, Rotate)
- Slide / Extend
- Angle
Box Morphing
Modification of Boxes

- Move (Translate, Rotate)
- Slide / Extend
- Angle
- Fit (edges, surfaces)
- Radius
- etc.
Morphing Constraints – Nested Elements

- Applicable for Direct and Box Morphing
- Rigidize or freeze features during morphing actions
Morphing Constraints – Nested Elements

- Applicable for Direct and Box Morphing
- Rigidize or freeze features during morphing actions

With Nested Elements

Without Nested Elements
Morphing Constraints – Nested Elements

- Applicable for Direct and Box Morphing
- Rigidize or freeze features during morphing actions
Morphing Constraints – Nested Elements

- Applicable for Direct and Box Morphing
- Rigidize or freeze features during morphing actions
Morphing Constraints – Nested Elements

- Applicable for Direct and Box Morphing
- Rigidize or freeze features during morphing actions
Record Morphing Actions

Deformation Parameter

• Records any direct or box morphing action
• Get any interpolation / extrapolation between undeformed and deformed shape with a single parameter

Initial shape – start recording
Record Morphing Actions

Deformation Parameter

• Records any direct or box morphing action
• Get any interpolation / extrapolation between undeformed and deformed shape with a single parameter

Initial shape – start recording

Edge Fit

Move Free

Deformed shape – stop recording
Record Morphing Actions

Deformation Parameter

• Records any direct or box morphing action
• Get any interpolation / extrapolation between undeformed and deformed shape with a single parameter

Initial shape – start recording

Deformed shape – stop recording
Record Morphing Actions

Deformation Parameter

• Records any direct or box morphing action
• Get any interpolation / extrapolation between undeformed and deformed shape with a single parameter

Initial shape – start recording

Deformed shape – stop recording
Mapping of Deformations

- Morph according existing deformation field:
  - 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 Direct and Box Morphing
• Obtained from FE mesh or CAD geometry
Functionalities assisting Morphing Part Manager

- Useful for Box Morphing (esp. complex configurations)
- To organize morph contents
Functionalities assisting Morphing
Reconstruct / Smooth morphed mesh

- Suitable for Direct and Box Morphing
- Improve mesh after morphing with large deformations
Functionalities assisting Morphing
Reconstruct / Smooth morphed mesh

- Suitable for Direct and Box Morphing
- Improve mesh after morphing with large deformations
Functionalities assisting Morphing
Reconstruct / Smooth morphed mesh

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

Visualize Morphing Deviations

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

- For parameterization of solver card entries
- Different types; Expressions
- Import from / Export to *PARAMETER
ANSA Parameter

• For parameterization of composite properties, e.g.:
  – fabric orientation
ANSA Parameter

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