

MASSOUD Theory

**Multidisciplinary Aerodynamic-Structural
Shape Optimization Using Deformation**

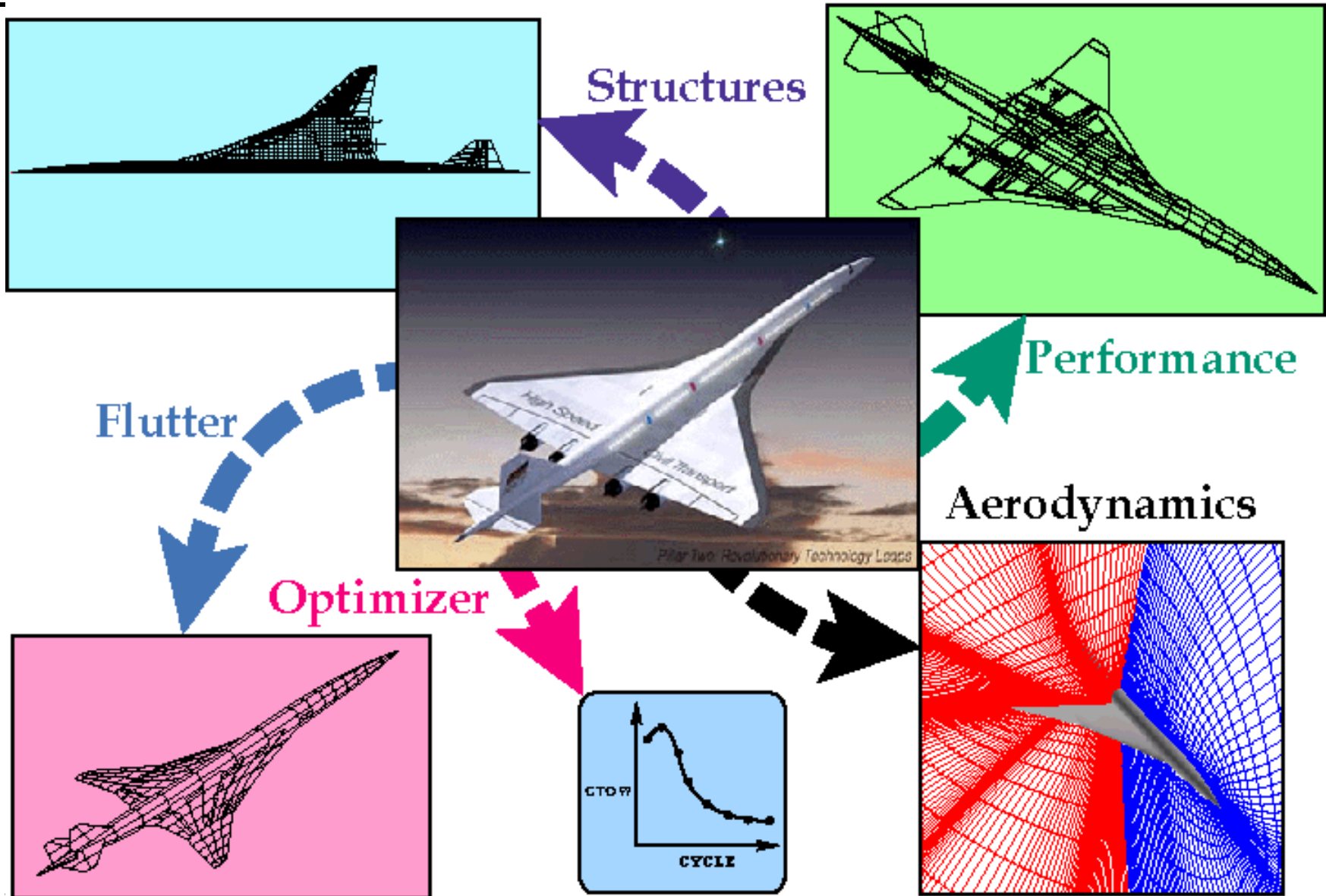
AIAA-2000-4911

Jamshid A. Samareh

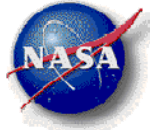
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Multidisciplinary Shape Parameterization



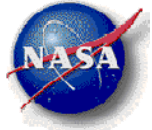
Three Key Ideas



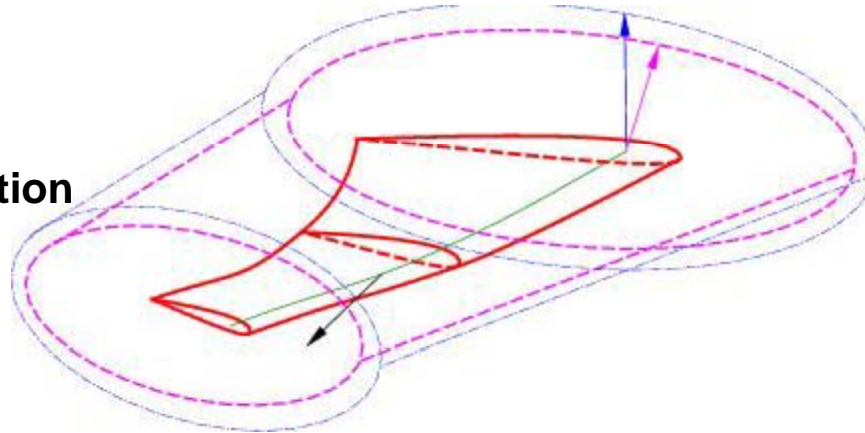
- Uses advanced soft object animation algorithms for deforming grids
 - Nonlinear global deformation (twist and dihedral)
 - NURBS surface (camber and thickness)
 - Free-form deformation (planform)
- Parameterizes the discipline grids (avoids manual grid regeneration)
- Parameterizes the changes in shape, not the shape itself (reduces the number of design variables)

Twist and Dihedral

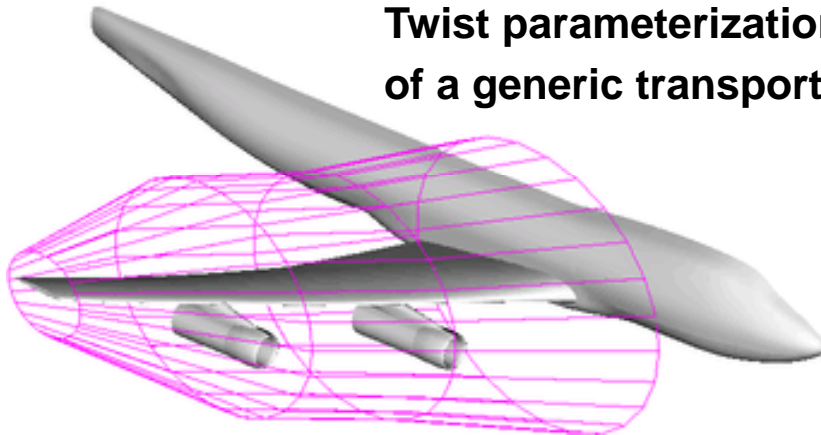
Nonlinear Global Deformation



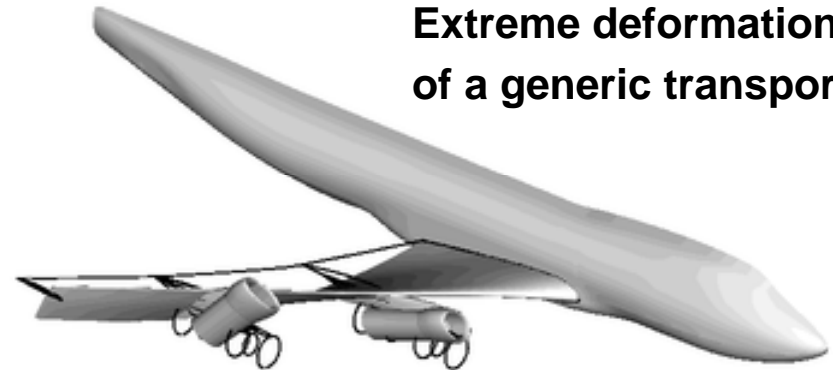
Twist parameterization
of a generic wing



Twist parameterization
of a generic transport

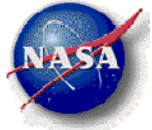


Extreme deformation
of a generic transport

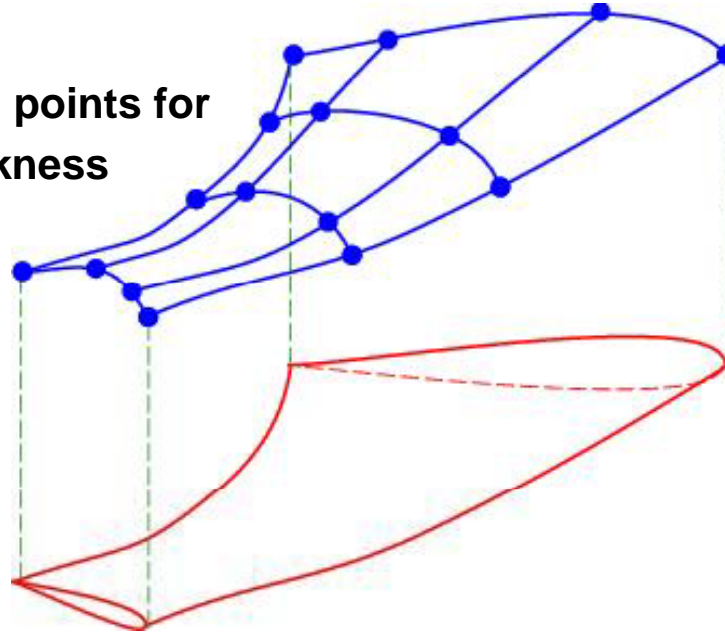


Camber & Thickness

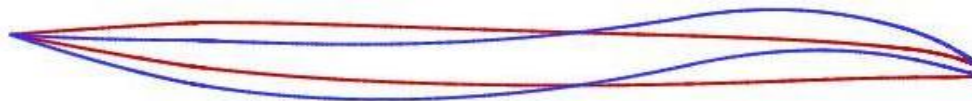
NonUniform Rational B-Spline (NURBS)



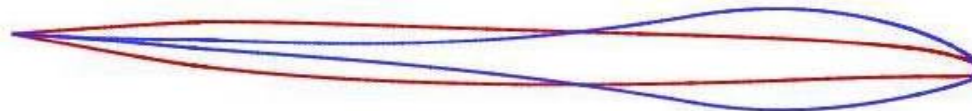
NURBS control points for
camber & thickness



Camber



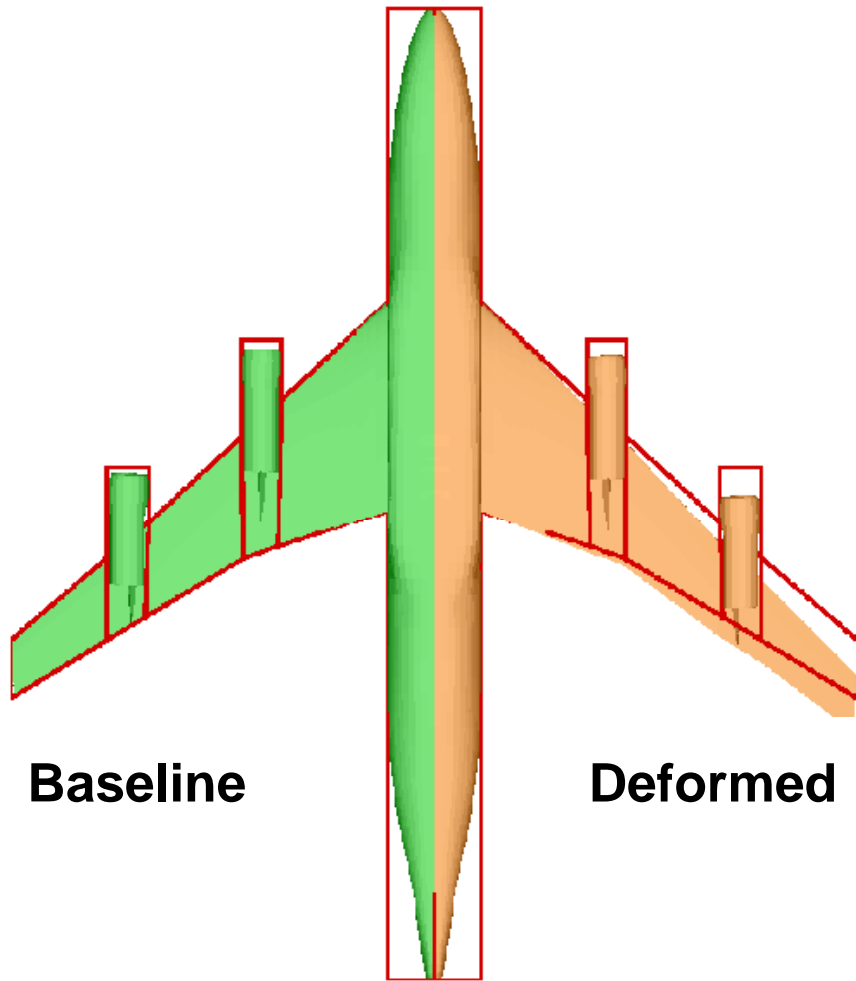
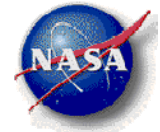
Thickness



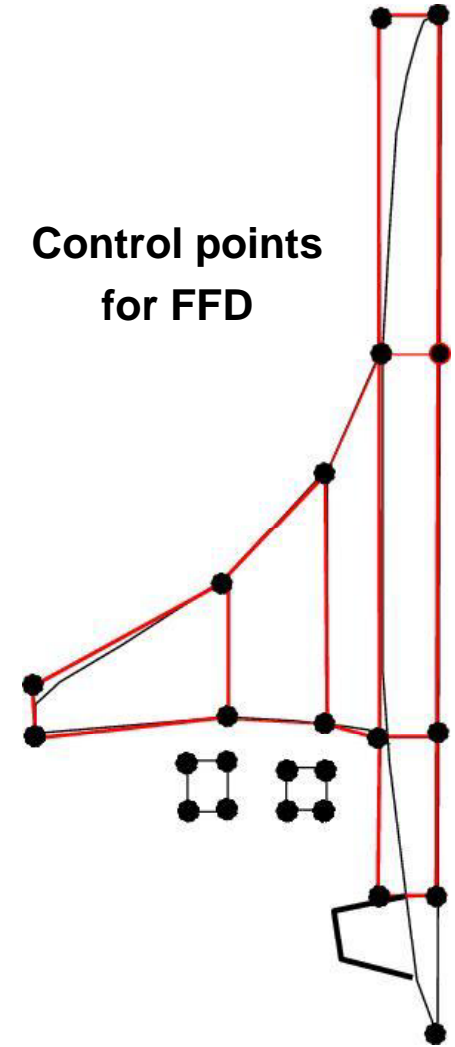
**Extreme camber &
thickness deformation**

Planform Parameterization

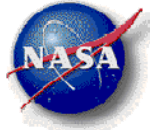
Free-Form Deformation (FFD)



Control points for FFD

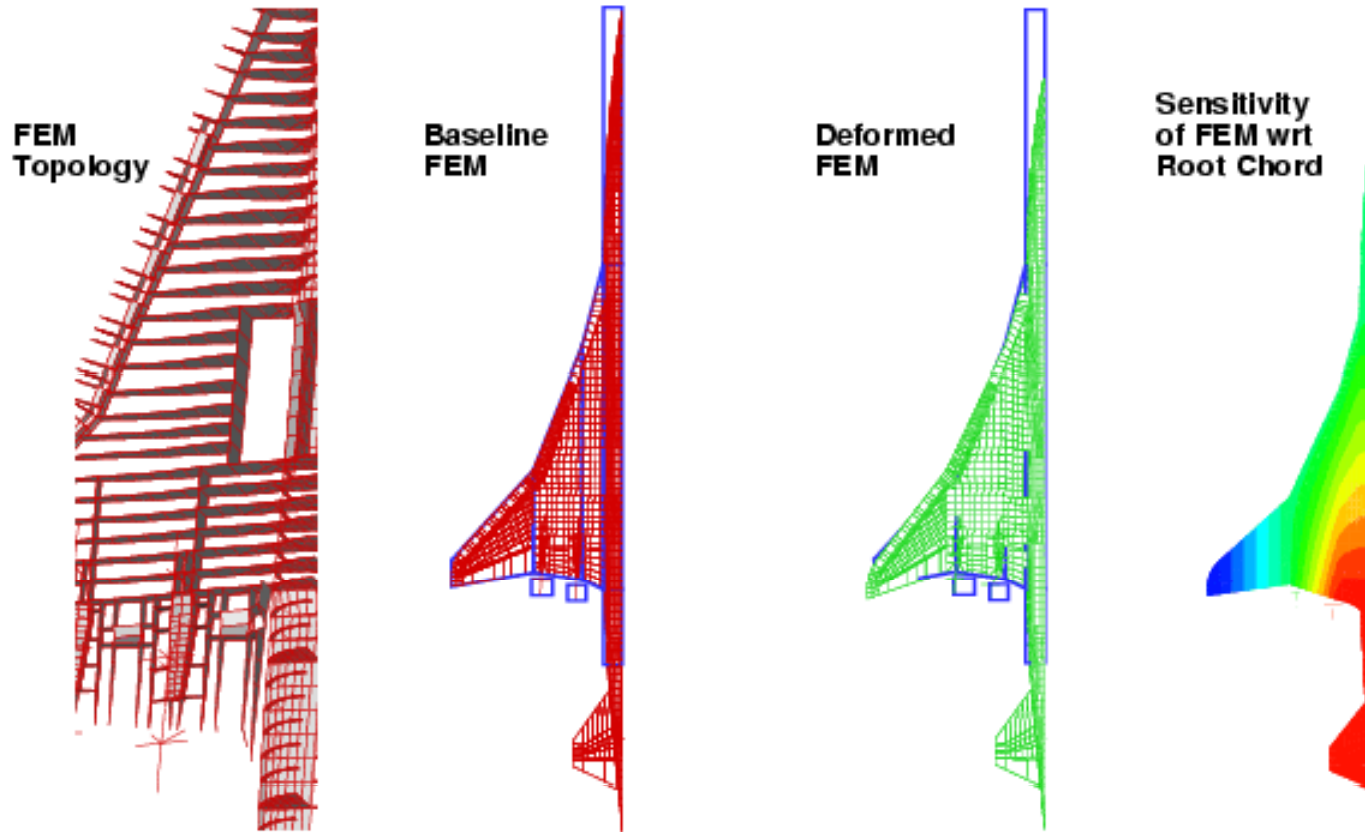


Multidisciplinary Shape Parameterization of an HSCT Model (FEM)

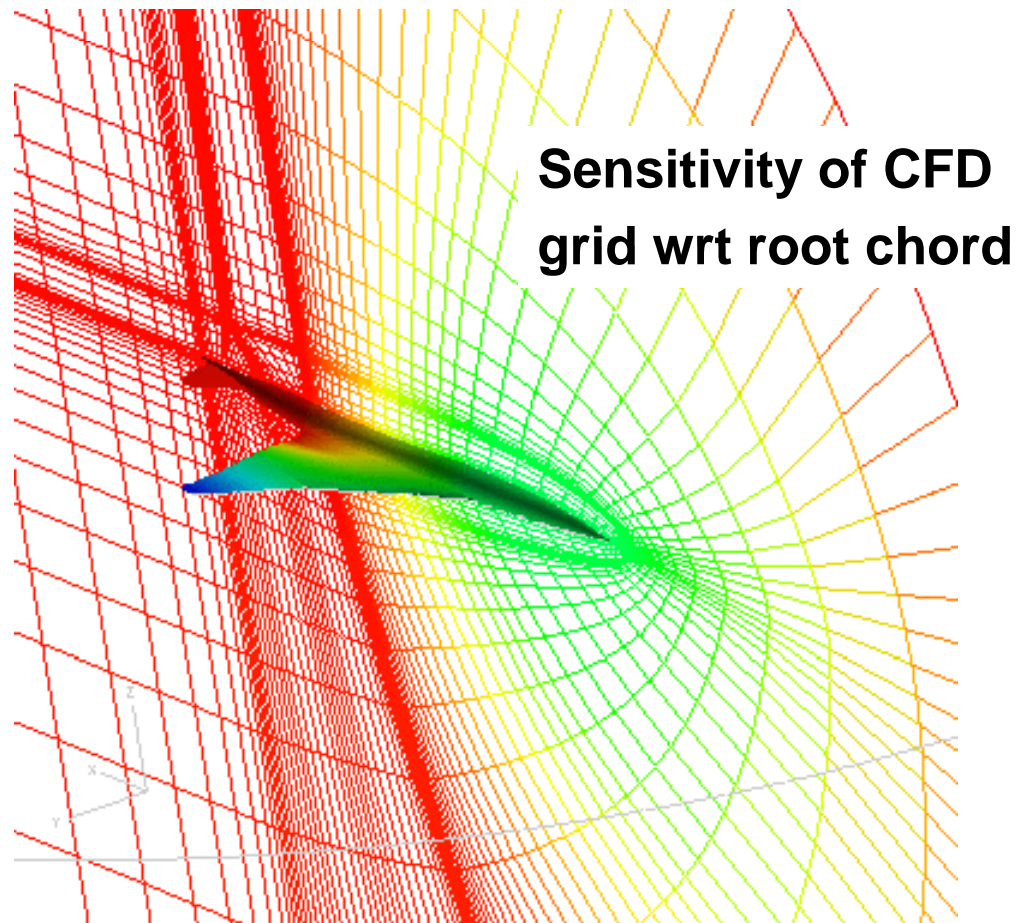


27 design variables

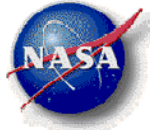
HSCT Structures Model



Multidisciplinary Shape Parameterization of an HSCT Model (CFD Model)



MASSOUD Pros & Cons



Pros

- Is Consistent
- No need for grid generation
- Easy to setup (hours)
- Parameterization is fast
- Analytical sensitivity is available
- Has compact set of DVs
- Suitable for high- and low-fidelity applications

Cons

- Limited to small shape changes
- Fixed topology
- No built-in geometry constraints
- No direct CAD connection