

# FSI/FSCON

Coupling Tools for Fluid/Structure Interaction

A Short Overview

SMR Engineering & Development

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<http://www.smr.ch>

# Projects and Partners



**RUAG**

Aerospace Defence Technology

CFS Engineering

TAURUS

FSI/FSCON can be applied to typical problems of aero-elasticity such as:

Unsteady: Flutter analysis, Buffeting.

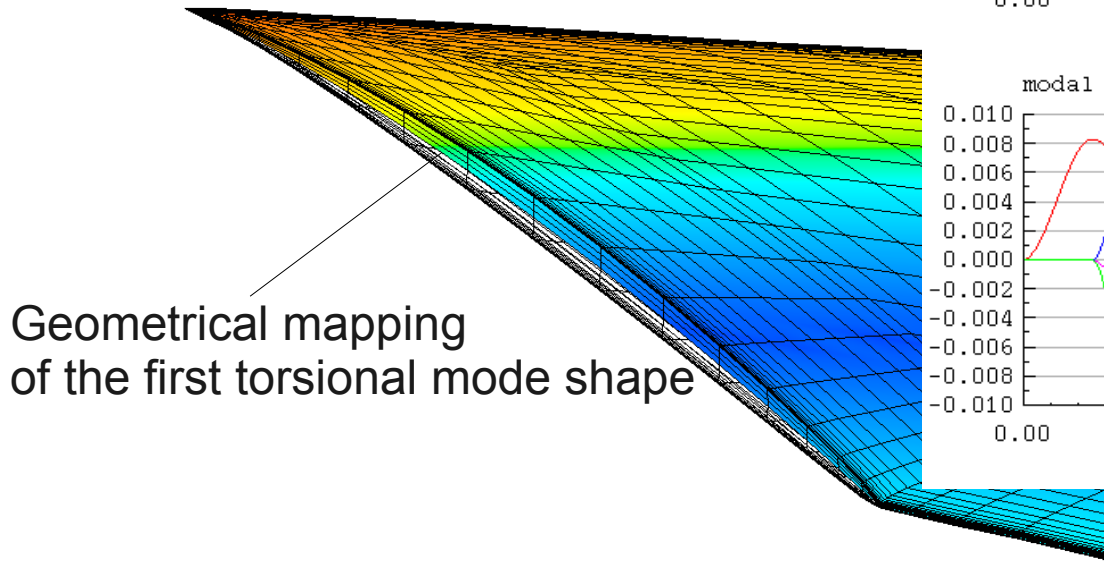
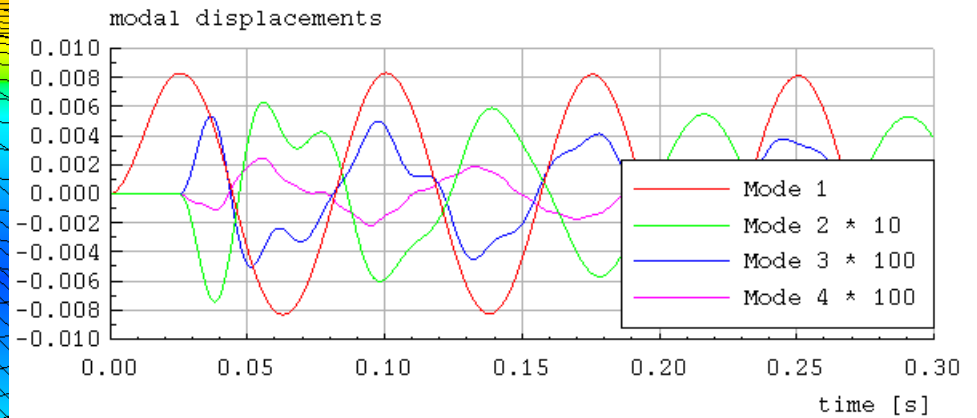
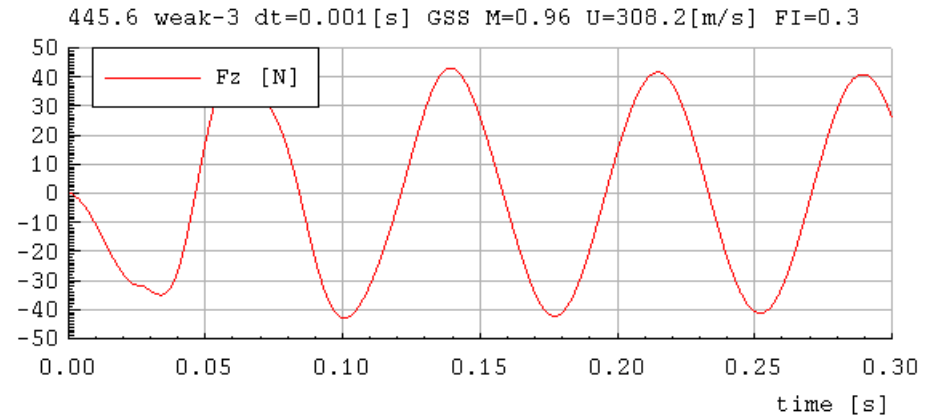
Steady: Load distribution, divergence, control reversal.

Especially suited where advanced multi-region coupling post-processing capabilities are required.

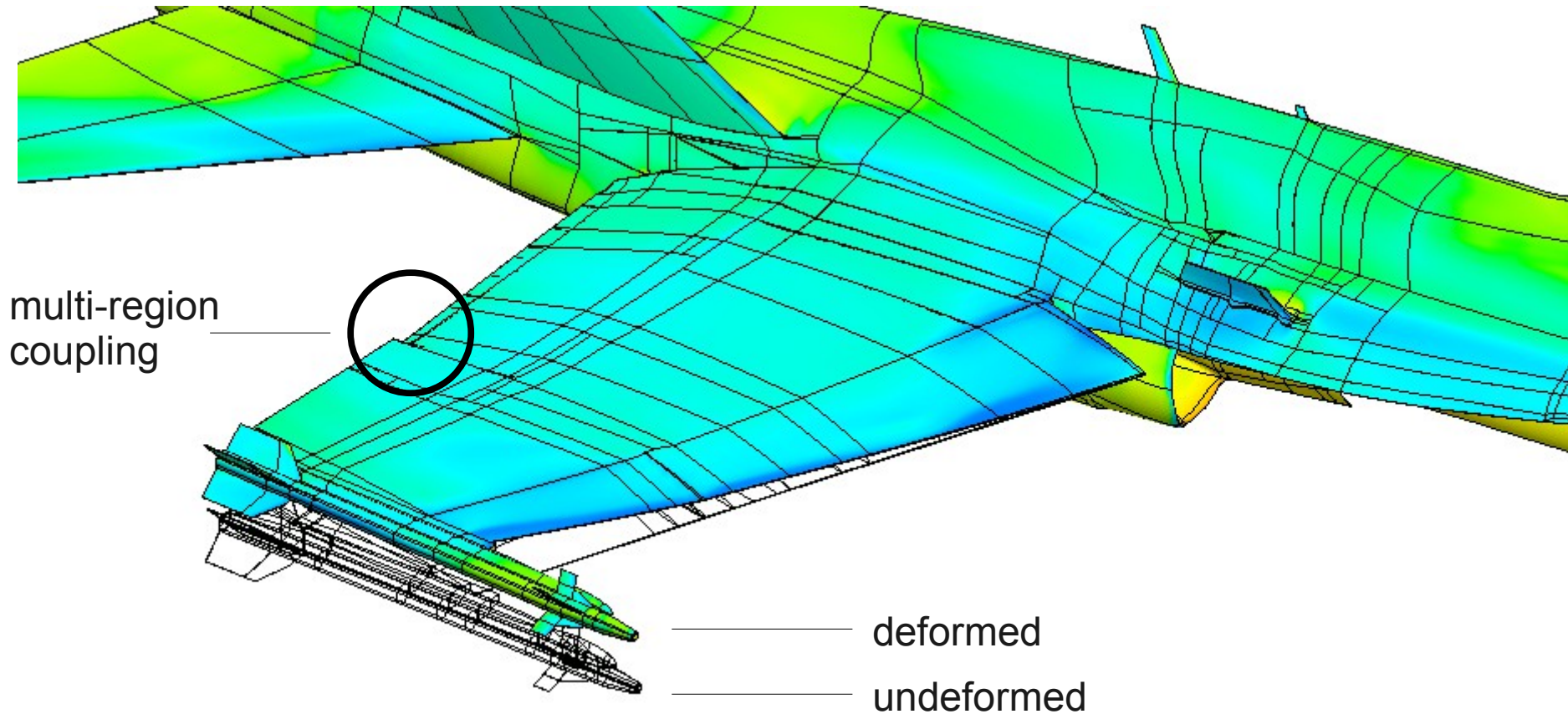
Can be integrated with structured and unstructured CFD solvers.

Supports direct and modal solution techniques for the structural domain.

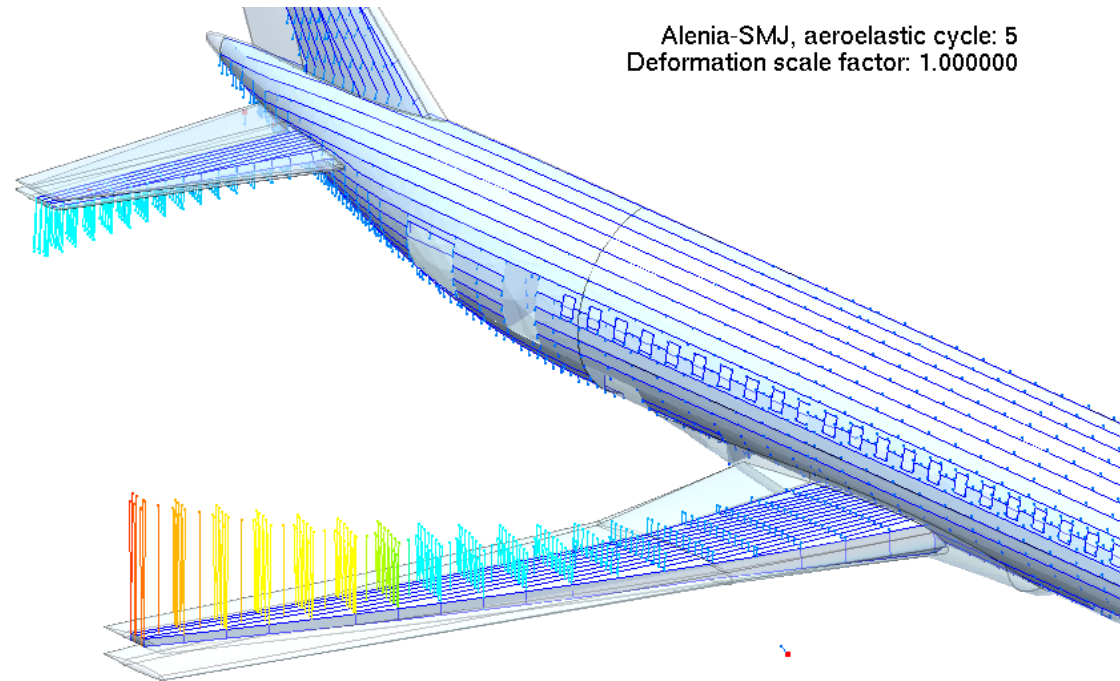
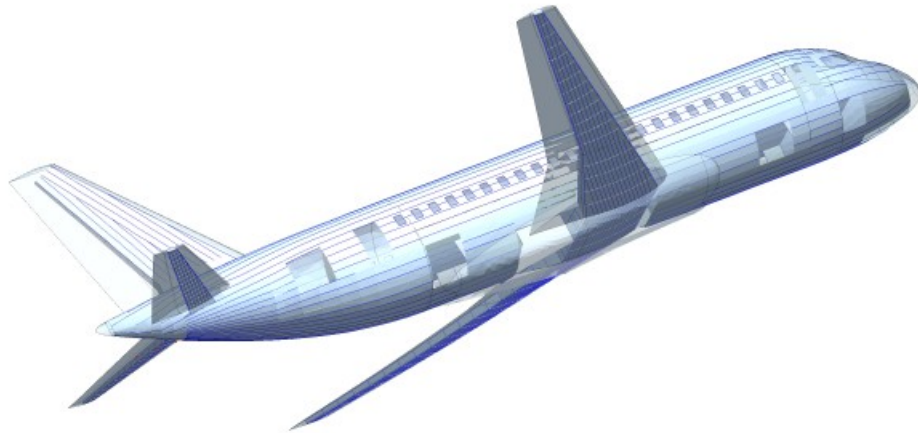
Determine flutter index speed of stability boundary.



Determine aero-elastic equilibrium (pressures, displacements).



Determine aero-elastic equilibrium shape.



Determine structural forces.



Integration of CFD pressures to concentrated aerodynamic loads at CFD surface nodes (structured CFD codes).

Fully conservative geometrical multi-region coupling:

- Interactively define coupling regions.

- Transfer forces and displacements.

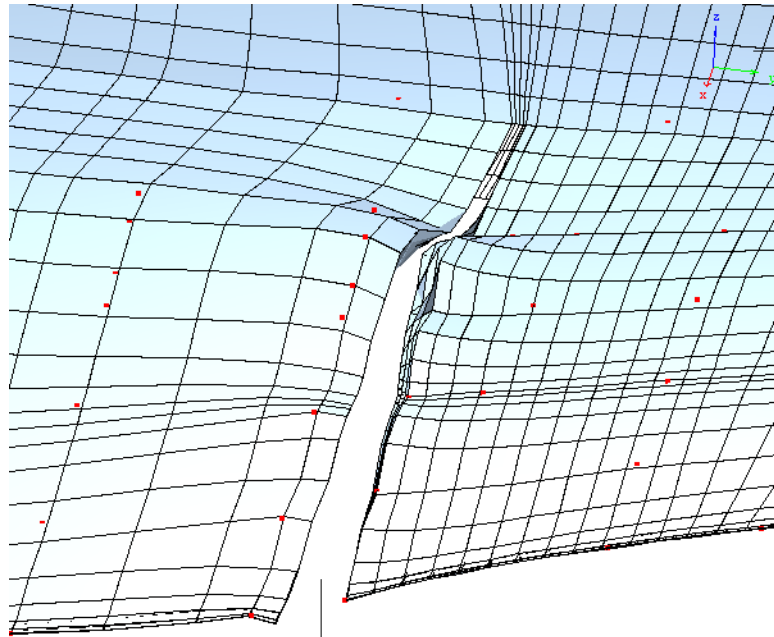
- Map structural mode shapes to fluid surface.

- Transfer heat and temperatures.

For unsteady aero-elastic problems:

- CSS and GSS collocation schemes.

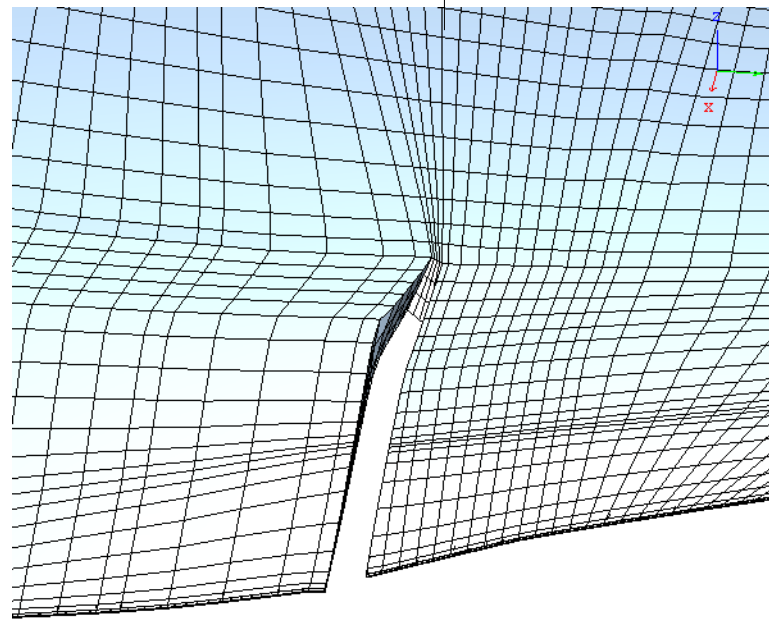
- Step-by-step modal time-integration (Newmark).



single-region coupling

control surfaces must  
move independently!

Multi-region coupling





- Enforce continuity between adjacent coupling regions.
- Set displacement constraints (e.g. For symmetry planes).
- Must be conservative (especially for stability problems like flutter).
- Definitions of coupling regions and their properties should be possible with a graphical tool (FSCON).

# FSCON: Connect FSI Coupling Regions

The screenshot shows a software interface for editing a model object named "FSCON-E\_1". The interface includes a menu bar (File, Settings, Help, Applets, Wizards), a toolbar (Edit, Message Log, Command Line), and a tree view showing the model structure. The main area displays a 3D mesh of a curved structure, with different regions highlighted in yellow, cyan, and magenta. A table titled "Selections and Coupling Groups" is overlaid on the right side of the mesh. The table has columns for Name, Show, Group, Mask, Zero, Colours, and Elements. The table lists several groups, including "Default" and "wingbox", with their respective masks, zero values, colors, and element counts. Buttons for "Insert filter" and "Remove" are visible below the table. A "Save settings and connectivity groups" button is located at the bottom right of the interface.

Name	Show	Group	Mask	Zero	Colours	Elements
CFD far field		Default	/ 0x0	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	8068
		Default	/ 0x0	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	41822
		wingbox	/ 0x1	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	72
	<input type="checkbox"/>		<input type="checkbox"/> Invert		<input type="button" value="Insert filter"/>	
	<input type="checkbox"/>		<input type="checkbox"/> Invert		<input type="button" value="Insert filter"/>	
					<input type="button" value="Remove"/>	
	<input type="button" value="Save"/>	<input type="button" value="Undo"/>	<input type="button" value="Clear"/>			
		Default	/ 0x0	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	7876
		wingbox	/ 0x1	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	1500
		wingbox	/ 0x1	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	1079
		wingbox	/ 0x1	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	737
		Default	/ 0x1	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	7028
		wingbox	/ 0x1	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	68
		wingbox	/ 0x1	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	68
		wingbox	/ 0x1	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	4206
		Default			<input type="checkbox"/> <input type="checkbox"/>	0

FSI/FSCON has been integrated so far with the following CFD codes:

TAU (unstructured, by DLR)

NSMB (structured, by NSMB consortium)

FSCON and static-FSI requirements:

Access to the CFD surface mesh (PLOT3D, Tecplot, NSMB/MemCom, TAU/NetCDF, etc.).

Access to CSM load point coordinates (ASCII, Nastran-BDF, B2000/MemCom, etc.).

For modal solution technique: Access to CSM mode shapes (ASCII, Nastran-BDF, MemCom, etc.)

The baspl++ post-processor supports typical tasks:

In structured and unstructured CFD (cuts, contours, streamlines).

Structural FE analysis such as deformation-, heat-, or stress analysis.

Data extraction, XY-plots, advanced scripting in Python.

Various post-processing tools in FSI/FSCON make use of baspl++.