Smart|Coupling

Fluid-Structure Interaction made easy

What is Smart|Coupling?

Smart|Coupling is a program for coupling and linking of mathematical models coming from different disciplines, thus allowing a seamless multiphysics interaction.

The software enables coupling of models with different discretization (grids, coordinate systems, units). The coupling can be done manually or half-automatically. **Smart|Coupling** can also interpolate values in nodes or elements/cells, transferring results from one to another grid.

Smart|Coupling is able to transfer data between the major CAE platform in the market:
- Pressure field from CFD to FEA (for FSI)
- Displacement field from FEA to CFD (for FSI)
- Temperature field from CFD/Thermal Codes to FEA.
- Plastic Strain from Process Simulation to FEA

The typical workflow with **Smart|Coupling** is:
- Import the source model, the one from which you want transfer the data
- Import the destination model, the one where you want apply the data
- Follow the wizard for grid pairing and model clean up
- Export the interpolated data field to the destination model

Smart|Coupling allows true multiphysics without changing your CAE tools or your procedures.

Multiphysics Analysis made real

Many real-world physical problems that engineers and scientists must solve involve the simultaneous interaction of two or more physical effects. Common investigations related with product performance are:

- Fluid Solid Interaction (FSI) Analysis (fluid /structural coupling)
- Thermal/Stress Analysis (thermal /structural coupling)
- Joule Heating (thermal/electric /structural coupling)
- MEMS Actuation (electrostatic /structural without fluid coupling) just to name a few.
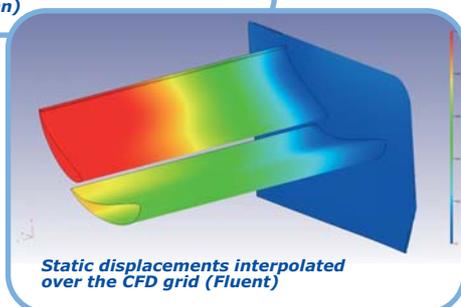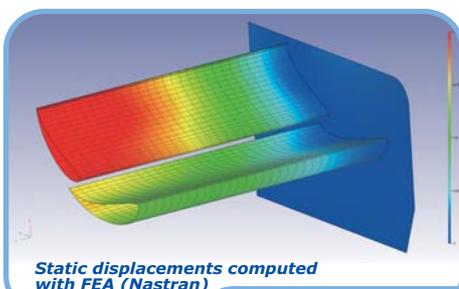
On the other hand, each physical problem is governed by different laws and equations and engineers often use specialty CAE software for each discipline:

- Finite Element Analysis (FEA) for structural analysis
- Thermal codes for radiation /convection /conduction thermal flow
- Computing Fluid-Dynamics (CFD) for fluid analysis
- Explicit FEA codes for process simulation and crash analysis

In general, different CAE disciplines need specific modelling strategies (grid shape, system units, etc.) and, often, it is not possible to use one and the same model for different simulations.

With **Smart|Coupling** that is not a problem! Its tools for grid matching and data interpolation give you the possibility to quickly transfer data and results between different CAE tools, even on heterogeneous OS platform (e.g. transfer a wall pressure field form Fluent on UNIX to Nastran on Windows).

Fluid-Structure Interaction (FSI)

The fully coupled solution of fluid flows with structural interactions, is a rapidly evolving discipline and represents the natural next step in simulating mechanical systems.
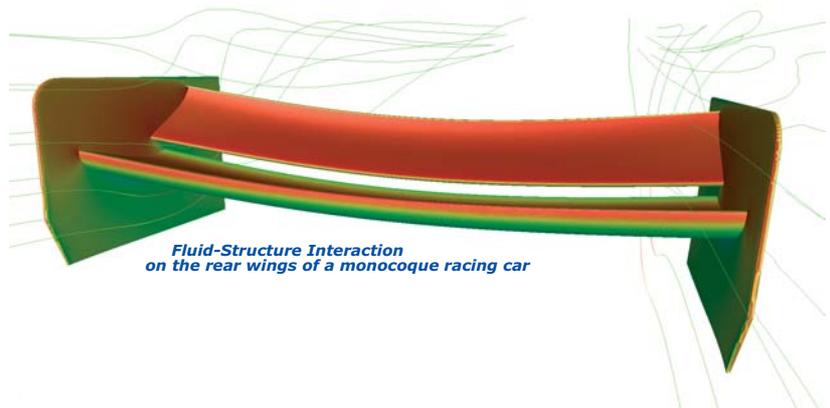
Fluid-Structure Interaction (FSI) is a true multiphysics phenomenon where a fluid flowing around or within a structure causes it to change shape due to flow-induced pressure loads. FSI simulations involve multiphysics coupling of fluid and solid mechanics.

Smart|Coupling offers special support for FSI analysis, by means of specific interfaces, tools and wizards for an easy and reliable bi-directional data transfer between CFD and FEA models.

Smart|Coupling supports the major CFD and FEA codes in the market:
- CFD: Fluent, StarCD, CFX, Neutral formats (Tecplot, EnSight)
- FEA: Nastran, Ansys, Abaqus, I-Deas

Smart|Coupling can easily dialog with your home-made CFD or FEA code, through specific custom interfaces.

Static displacements computed with FEA (Nastran)

Static displacements interpolated over the CFD grid (Fluent)

Fluid-Structure Interaction on the rear wings of a monocoque racing car

Technical Data

Smart|Coupling Features
- 3D presentation of models and their coordinate systems
- Possibility of manual grid matching (translation, rotation and scaling of each grid)
- Semi-Automatic grid matching based on inertia tensor and point location paired by the user
- Possibilities to clean the models by removing unused parts before the data interpolation
- Interpolation algorithm with least-squares minimization
- Manipulation of interpolated results (scale, offset)
- Graphical presentation of interpolated results
- Saving and loading the project for further job session

Supported results
- Physical properties (shell thickness, density, young modulus, etc.)
- Displacement
- Temperature
- Pressure
- Stress & strain tensor

Tools
- 3D visualization of models and analysis data with OpenGL support
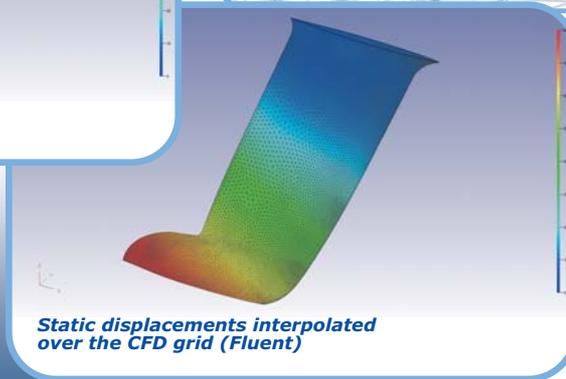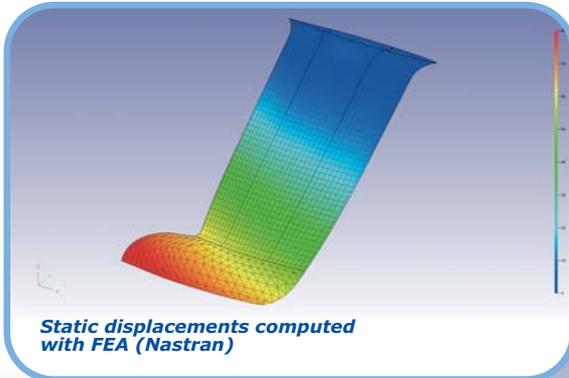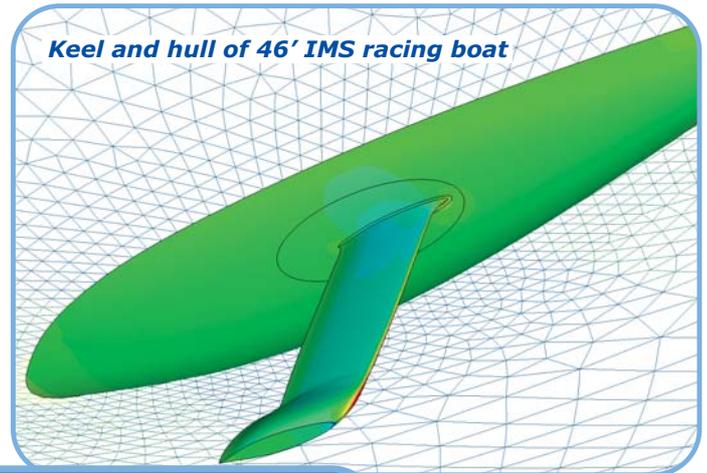- Wizard for Fluid-Structure Interaction (FSI)

Export
- Postscript
- GIF, RGB Files
- AVI, Movie Film
- VTF interactive models
- Excel output
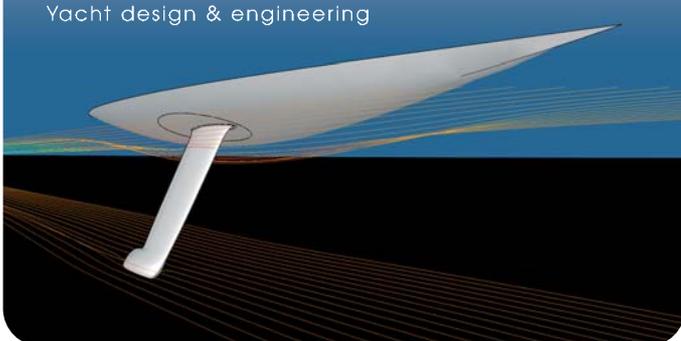- HTML presentation tool

Interfaces
- FEM – Structural and dynamic analysis
  - NASTRAN
  - I-DEAS
  - ANSYS
  - ABAQUS
- CFD – Fluid dynamics
  - Fluent
  - StarCD (available on demand)
  - CFX (available on demand)
- Explicit solvers – Process Simulation
  - Pam-Stamp
  - Pam-Crash
  - LS-DYNA 3D (available on demand)
  - ProCast
- Other special interfaces
  - Experimental data
  - Excel formats
  - user specific data

Hardware Supports
- Windows NT/2000/XP
- Linux
- SGI
- SUN
- IBM
- HP

Keel and hull of 46' IMS racing boat

Static displacements computed with FEA (Nastran)

Static displacements interpolated over the CFD grid (Fluent)

Courtesy of
ceccarelli
Yacht design & engineering

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