Barcelona, 27th - 28th February 2003

Multi-Physics and Analysis: Fluid-Structure Interaction Workshop

Background
During the first year of FENET project several workshops where organized to study the different typologies of coupling in MPA: one-way coupling, weak and strong coupling algorithms. Many different problems as well as possible alternative solutions have been presented and discussed among all the partners.

Objective
The main idea for this MPA session of the FENET workshop is to focus on a more specific area within the MP. According to this idea, the current MPA session is based on FLUID-STRUCTURE INTERACTION, including the following items:

•Aero-elasticity
•Aero-acustic problems
•MP in Aersospace
•MP in Marine
•MP in Offshore structure

Workshop
The workshop will be handled as a round-table dedicated to discuss the experience of the partners on FLUID-STRUCTURE INTERACTION: definition of the problem and possible solutions.

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Agenda

Multi-Physics and Analysis: Fluid-Structure Interaction Workshop

27th February 2003

14:00-14:10 **Workshop Introduction and Objectives**
Chairs: Dr. M. Chiumenti and Dr. E. Oñate (CIMNE, UPC)

MP Invited Sessions

14:10-14:40 **FE-particles Method for Fluid-Structure Interaction Problems**
Authors: Dr. E. Oñate and Dr. S. Idelsohn (CIMNE, ES)

14:40-15:10 **Structural Analysis of Sails**
Authors: G. Valdes and R. Rossi (Universidad Politécnica de Cataluña, UPC, ES)

15:10-15:40 **Advances in FEM for Ships Hydrodynamics**
Author: Dr. J. Garcia (COMPASS, ES)

15:40-16:10 **Refreshment Break**

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MP Invited Sessions

16:10-16:40 **Some implementation aspects of fluid-structure interaction problems**
Author: Dr. R. Codina (CIMNE, ES)

16:40-17:10 **The CD-adapco Group approaches to analysis of FSI problems.**
Author: Riaz Sanatian (CD-Adapco Group, UK)

17:10-17:40 **Coupled Fluid-Structure Acoustics Using PERMAS**
Author: Reinhard Helfrich (INTES GmbH, D)

20:30 **FENET Dinner**

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28th February 2003

08:30-09:00 **Welcome**
Chairs: Dr. M. Chiumenti and Dr. E. Oñate (CIMNE, UPC)

MP Invited Sessions

09:00-09:30 **ANSYS Multiphysics Fluid**
Author: David Ellis (IDAC Ltd)

09:30-10:00 **Coupling strategies in fluid-structure interaction problems using FEM & BEM**
Author: Dr. Stéphane Paquay (Open Engineering SA)

10:00-10:30 **Preliminary Investigations of Concorde Fuel Tank Impact**
Author: Dr. Moji Moatamedi (The University of Salford)

10:30-11:00 **Refreshment Break**

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MP Invited Sessions

11:00-11:30	**Fluid-Structure Interaction Methods in Practice – A Range of Techniques used in Commercial Codes to Industrial Problems**
Author:	Colin Hayhurst (Century Dynamics)
11:30-12:00	**Summary and final discussions**
12:00	**Lunch**

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- Coupling typology
- Expertise involved
- Numerical Tools be used
- New methodology to approach the problem
- Discretization problems
- Validation need

Coupling typology

Multi-Physics solution strategy depends on the type of **coupling**: it is possible to think of different solutions, more and more sophisticated, moving from **weakly-coupled** to **strongly-coupled** problems.

Real-life problems are MP problems, this means that the in the future we should move to MP software: today we tend to solve uncoupled problems because it is simpler and cheaper, tomorrow the standard could be MP analysis: more knowledge, more computer power, why not?

Expertise involved

Multi-Physics means **expertise** and **knowledge** of different fields (CSM, CFD,…) from the point of view of both *developers* and *users*.

Numerical tools to be used

To solve a Multi-Physics problem there are mainly two possibilities:

- Use **different codes** for each one of the physical phenomena involved:
  - Specific software focused on the solution of specific problem
  - Developers and user have separated knowledge and work on separated physics
  - Less efficient (i.e. DB exchange)
  - It could be the solution for *weakly-coupled* problems

- Use **one code**:
  - Only one *integrated* environment (starting developments from scratch)
  - *No inertia* coming from the use of traditional codes difficult to modify
  - Knowledge of different physics
  - Highly efficient (only one DB)
  - Adequate for *strongly-coupled* problems

New methodology

Recent challenges to solve MP problems: extension of FE method to *FE-particles method*. This means a **new methodology** to solve in an *alternative* manner complex problems involving:

•Fluid analysis in a lagrangian formulation
•Free-surface
•Waves
•turbulence
•Mixture of different fluids
•Fluid / Solid interaction
•Contact analysis

Discretization

Multi-Physics analysis may require different **time** and **space discretization** (i.e. aero-acoustic problems)

Mesh depends on the physics (i.e. temperature gradients, stress concentrations, turbulence,…)

Time integration scheme depends on the physics (i.e. frequencies, dynamics, …)
Sub-cycling can aid speed.

Validation

Multi-Physics solutions need both numerical and experimental **validation** as we can find in other fields like in sheet-metal-forming or casting.

It is crucial to know if what we get from the simulation is close to real-life behavior or it is just a *cartoon.*

It is difficult to define test cases.