Embedded Computational Fluid Dynamics techniques for Fluid-Structure Interaction problems

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ABSTRACT

Traditionally, the FSI problem has been solved considering a Lagrangian framework in the structure domain and an Arbitrary Lagrangian-Eulerian (ALE) framework in the fluid one. Even though this allows to consider the structure displacement in the fluid domain resolution, it is widely known that large structural displacements might lead to excessively distorted, or even inverted, elements.

Apart of other advantages, embedded mesh methods are proven to be a robust alternative to traditional body-fitted discretizations when dealing with large boundary movements. This feature allows to get rid of the fluid ALE mesh solver (the problem is solved in an Eulerian framework as usual) since the structure movement is tracked by updating the level-set function that represents the immersed object [1].

The use of embedded discretization techniques in an FSI solver has potential industrial applications, ranging from the simulation of biological tissues to the simulation of extremely lightweight structures, such as inflatable hangars or boat sails [2]. In this talk, the advances to exploit such embedded Computational Fluid Dynamics (CFD) technologies in the resolution of the Fluid-Structure Interaction (FSI) problem will be presented together with some preliminary results.

REFERENCES

[1] Baumgärtner, D. and Wolf, J. and Rossi, R. and Dadvand, P. and Wüchner, R. A robust algorithm for implicit description of immersed geometries within a background mesh. *Adv. Model. and Simul. in Eng. Sci.* (2018) **5**:21–41.

[2] Baumgärtner, D. and Wolf, J. and Rossi, R. and Wüchner, R. and Dadvand, P. *Contribution to the Fluid-Structure Interaction Analysis of Ultra-lightweight Structures using an Embedded Approach.* CIMNE Monograph series, Vol. 152, (2015).