The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5-9 June 2022, Oslo, Norway

FSI co-simulation around elongated bodies with a minimal intrusive interface for the beam solver

A.Leroyer*[1], G.B. Deng[1], E. Guilmineau[1], P. Queutey[1], M. Visonneau[1] and J. Wackers[1]

[1] LHEEA, UMR-CNRS6598, Centrale Nantes, 1 rue de la Noë, 44300 Nantes,
alban.leroyer@ec-nantes.fr

Keywords: *FSI, partitioned approach, ALE RANSE solver, beam model*

Numerous hydrodynamic configurations involving Fluid-Structure Interaction concern elongated structures which can be accurately and efficiently modelled with a 1D-beam. Vortex Induced Vibration with cables is a typical example. It is also the case of the hydrofoils which are more and more used in sailing boats.

This work aims at developping a flexible, robust and accurate partionned approach between a Reynods-Averaged Navier-Stokes Equation (RANSE) solver and a beam solver. The ISIS-CFD solver, developped in the METHRIC team at the LHEEA Lab. is based on a Finite-Volume approach which uses body-fitted meshes. Such an approach is suitable to capture accurately the turbulent boundary layers for high Reynolds configurations. When dealing with FSI configurations, an Arbitrary Lagrangian Eulerian (ALE) approach is then used, combined with an efficient two ways partitioned approach. However, to conserve the high Reynolds performance of ALE while getting closer to the versatility of non-body fitted approach such as Immersed Boundary methods, a combined use of the overset grid technique and adaptive grid refinement (AGR) can be applied.

A generic interface is proposed to couple any beam solver. The implementation uses the ZMQ library based on a TCP/IP protocol ([2]). Through an extension of [1] for slender bodies, stability issues due to added mass can be addressed into the fluid solver. As a result, it minimizes the modifications to be done in the beam solver, which can almost be seen as a black box. The only requirement is to have access to the temporal loop and to be able to solve the beam displacement several times at the same time step while updating fluid loads until convergence.

REFERENCES

[1] Yvin, C. , et al. Added mass evaluation with a finite-volume solver for applications in fluid–structure interaction problems solved with co-simulation *Journal of Fluids and Structures*, **Vol.** 81, pp 528–546, 2018.

[2] P. Hintjens, ZeroMQ: Messaging for Many Applications, *O'Reilly Media, Inc.*, 2013.