11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20–25, 2014, Barcelona, Spain

PARALLEL INCOMPRESSIBLE FLUID-STRUCTURE SIMULATIONS BASED ON A ROBIN-NEUMAN EXPLICIT COUPLING PARADIGM

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Key words: *Multiphysics Problems, Fluid-structure interaction, Parallel Methods, Domain decomposition.*

In the literature, there is a permanent debate on monolithic versus partitioned methods for the effective numerical solution of incompressible fluid-structure interaction problems (see, e.g., [5, 2, 4, 1]). In this work we follow a partitioned approach. In this context, an effective solving requires robust coupling algorithms and efficient solvers for both the solid and fluid. The coupling procedure is based on the explicit Robin-Neumann schemes recently introduced in [3]. Hence, the fluid and solid solvers are invoked only once per time-step.

A fundamental advantage of such a partitioning approach, as far as parallelization is concerned, is that separate solvers can use different well adapted parallel strategies. We introduce a multi-level parallel implementation. A master/slave paradigm is used, the master implements the coupling algorithm, and the slaves are independent fluid and structure softwares. It is thus possible to use different parallel approaches for the solid and fluis solver. Both fluid and solid are in house softwares. The fluis solver, FELiScE [6], is based on PETSc and thus uses the parallel features inclosed. The parallel structural solver is based on a BDM (balancing) domain decomposition method [9, 8, 7], which is here adapted to the time dependent problem. The key point in this algorithm is the construction of the coarse space, which will be detailed.

An additional versatility of the present approach is that it allows, not only to change the fluid or solid solver if a different one more effective becomes available, but also to successfully combine MPI and PVM. Numerical results will illustrate the ability of this approach to solve large scale problems.

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