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STUDY OF AN ASYNCHRONOUS ALGORITHM IN THE FSI DOMAIN

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Given the wide range of applications where fluid-structure interaction (FSI) is present, modelling and understanding this phenomena has become an established branch of computational science.

To numerically model complex configurations, which are expensive in terms of computation time, this work proposes and studies an asynchronous algorithm[1] that breaks the standard exchange of information governed by classical coupling schemes like that of Schwartz. The idea is to be optimal in the transfer of data while remaining robust, stable, and showing scalability in distributed memory systems.

Within the framework of partitioned schemes, when a strong coupling in the physics is present, an iterative process is required at each time step to find the convergence of the interaction[2]. The principal idea behind the proposed algorithm is to ensure blocking exchange of information at each time step, but not within the loop of convergence.

While the exchange of data between the solvers at each time step is forced, communication within the nonlinear iterations is free to occur when the information is available. To do so, a mean of non-blocking communication is left open within the internal loop. Using this medium, each code makes available its results when it finishes its own calculation, and retrieves information from its counterpart in the case that it is already available. In the case that no new information has been placed, the solver will make a new calculation using the same information from its counterpart (the last information that was received) and its own updated information (the result of its own prior calculation).

The implementation of this algorithm optimizes the computational time by avoiding downtime due to waiting between the solvers, but also opens the door to other possibilities. Such is the case of an algorithm that will be guided by the complexities of the coupling, deciding on its own when the exchange of information is required. It has been shown that using the asynchronous approach, the number of FSI iterations of the more expensive solver involved in the coupling matches the number of iterations of the synchronous algorithm. Tests to prove that the algorithm can naturally shift within the range of traditional implicit and explicit algorithms as necessary are shown.

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