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A partitioned simulation approach for fluid-structure interaction induced vibrations of ship propellers

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The numerical simulation of ship propellers constitutes a versatile tool for the development of improved designs. Using a partitioned solution approach the strongly coupled fluid-structure interaction (FSI) problem can be solved in order to account for both, changes in the shape as well as the material. We make use of the coupling manager *comana* to realize the data exchange between the fluid and the structural solver. The fluid mechanics subproblem is governed by the Euler equations and solved using a first order panel method [1]. The structural problem is solved using high-order finite elements. The coupled simulations are used to investigate the acoustic behavior of ship-propellers. The structural vibrations are of particular interest since they define the boundary values for a separate acoustic simulation predicting the sound radiation. In order to efficiently predict the vibrations within the fully coupled FSI simulation, the structural subproblem demands for a much smaller time step than the fluid subproblem, which is realized using a sub-cycling pattern in the coupling algorithm. The small time step size allows for an explicit time integration method to be applied on the structural side. The efficiency of the structural mechanics subproblem can be further increased by applying mass lumping techniques. In the scope of high-order finite elements, this can be achieved by a combination of certain quadrature rules (e.g Gauss-Lobatto (GL)) and shape functions (e.g. Lagrange shape functions through GL points) [2]. In our presentation, we will focus on the interplay of the sub-cycling pattern, the time integration method and the convergence acceleration method applied to stabilize the coupling iterations.

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