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ADDED MASS AND PARTITIONED ITERATIVE SOLUTION METHODS FOR FLUID-STRUCTURE INTERACTION

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The basic subiteration method for fluid–structure interaction (FSI) problems is based on a partitioning of the fluid–structure system into a fluidic part and a structural part. The effect of the fluid on the structure can be represented by an added mass [1-2] to the structural operator. This added mass can be identified as an upper bound on the norm or spectral radius of the Poincaré–Steklov operator of the fluid. The convergence behavior of the subiteration method depends sensitively on the ratio of the added mass to the actual structural mass. For FSI problems with large added-mass effects, the subiteration method is either unstable or its convergence behavior is prohibitively inefficient.

In recent years, several more advanced partitioned iterative solution methods have been proposed for this class of problems, which use subiteration as a component. The rudimentary characterization of the Poincaré–Steklov operator provided by the added mass is, however, inadequate to analyze these methods. Moreover, this characterization is inappropriate for compressible flows. In this paper, we investigate the fine properties of the Poincaré–Steklov operators and of the corresponding subiteration operators for incompressible- and compressible flow models and for two distinct structural operators. Based on the characteristic properties of the subiteration operators, we subsequently examine the convergence behavior of several partitioned iterative solution methods for FSI [3-4].

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