Robust Discretization and Solution Strategies for Moving-Domain Fluid-Structure Interaction Problems

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The presentation is focused on the computational framework that involves coupling of incompressible flow and large-deformation structural mechanics. The formulation of fluid mechanics on the moving domain is presented, and efficient solution strategies for the underlying linear equation systems are discussed. A framework for computational fluid-structure interaction (FSI) based on the Arbitrary Lagrangian-Eulerian formulation is presented. Basics of Isogeometric Analysis are also shown. The fluid-structure interface discretization is assumed to be nonmatching allowing for the coupling of standard finite-element and isogeometric discretizations for the fluid and structural mechanics parts of the FSI problem, respectively. FSI coupling strategies and their implementation in the high-performance parallel computing environment are also discussed and computational challenges presented. Simulations ranging from cardiovascular fluid mechanics and FSI to full-scale wind-turbine FSI are presented (see, e.g., Figure 1).

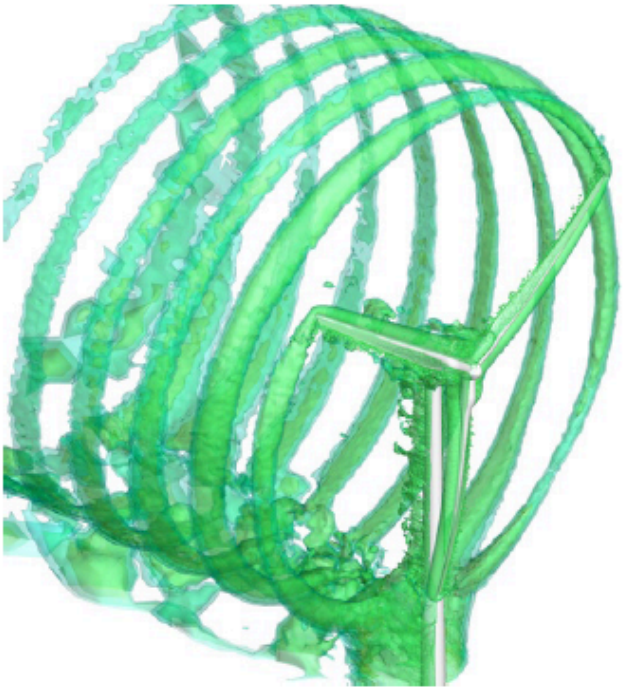

Figure 1. FSI of a 5MW offshore wind turbine at full scale