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Goal-Adaptive Methods for Fluid-Structure Interaction

The numerical solution of fluid-structure-interaction problems poses a paradox in that most of the computational resources are consumed by the subsystem that is of least practical interest, viz., the fluid. Goal-adaptive discretization methods provide a paradigm to bypass this paradox. Based on the solution of a dual problem, the contribution of local errors to the error in a specific goal functional is estimated, and only the regions that yield a dominant contribution are refined.

In this presentation, I will discuss some basic aspects of fluid-structure interaction and recent progress in the development of goal-adaptive approximation methods for this class of problems and, more generally, boundary-coupled problems and free-boundary problems. In general, two fundamental complications must be addressed to apply goal-adaptive methods to fluid-structure interaction. Firstly, the formulation (interpretation) of the interface coupling conditions has non-trivial consequences for the dual problem [1-3]. Secondly, the domain dependence engendered by the free-boundary character results in complicated shape derivatives in the linearized dual problem [3-5]. The presentation addresses both these complications. Numerical results are presented to illustrate the differences in the various formulations, and to exhibit the potential of goal-adaptive methods for fluid-structure-interaction problems.

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- [2] P.W. Fick, E.H. van Brummelen, and K.G. van der Zee, On the adjoint-consistent formulation of interface conditions in goal-oriented error estimation and adaptivity for fluid-structure interaction, *Comput. Methods Appl. Mech. Engrg.* 199 (2010), 3369—3385.
- [3] K.G. van der Zee, E.H. van Brummelen, I. Akkerman, and R. de Borst, Goal-oriented error estimation and adaptivity for fluid-structure interaction using exact linearized adjoints, *Comput. Methods Appl. Mech. Engrg.* 200 (2011), 2738—2757.
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