Computational Fluid—Structure Interaction with Applications

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ABSTRACT

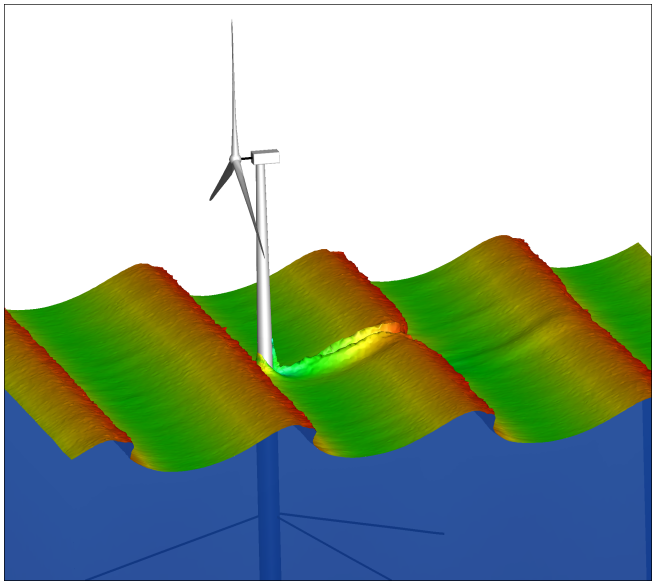

Figure 1. FSI simulation of an offshore wind turbine design utilizing a spar buoy concept.

The presentation is focused on the computational framework that involves coupling of fluid flow and structures undergoing large deformations [1]. The formulation of fluid mechanics on the moving domain is presented. A framework for computational fluid-structure interaction (FSI) based on the Arbitrary Lagrangian-Eulerian formulation is presented. Although the framework was developed in the context of interface-tracking mesh-moving methods, it is actually applicable to the case when the structural geometry is immersed in the fluid mechanics domain, which may or may not be in motion, leading to a technique that involves interface capturing. Basics of Isogeometric Analysis [2] are also discussed. 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 Figure 1).

REFERENCES

[1] Y. Bazilevs, K. Takizawa, and T. E. Tezduyar. *Computational Fluid–Structure Interaction: Methods and Applications*. Wiley, 2013.

[2] J.A. Cottrell, T.J.R. Hughes, and Y. Bazilevs. *Isogeometric Analysis: Toward Integration of CAD and FEA*. Wiley, 2009.