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ISOGEOMETRIC FSI SIMULATIONS

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Coupled fluid-structure interaction (FSI) simulations of wind turbines have traditionally been considered computationally too expensive to carry out. However, more powerful computers and better solution techniques based on isogeometric analysis can make such simulations viable.

An important goal in isogeometric analysis is to represent the geometry exactly on the coarsest grid. Development has firstly been motivated by the need for simplifying building detailed analysis models from CAD representations [1]. Secondly, once an initial mesh has been constructed it is advantageous to avoid further communication with the CAD geometry system. A key feature of the isogeometric approach is therefore to use the same set of basis functions for both the geometry and the analysis. An attractive feature of isogeometric analysis is using non-uniform rational B-splines (NURBS) for representing complex, smooth geometrical shapes. The solution per-degree-of-freedom accuracy is usually better for isogeometric analysis than for low-order finite elements.

Accurate modelling of wind turbines requires coupled fluid-structure interaction (FSI) simulations. Wind speed and air flow influence the motion and deformation of the wind turbine blades. At the same time, the motion and deformation of the blades influence the air flow. We present results obtained for a pitching airfoil (NACA 0012) at Re=980000 using Spalart-Allmaras turbulence model. Our study gave results that compares well with experiments reported by McAlister *et al*. (1982).

REFERENCES

[1] T.J.R. Hughes, J.A. Cottrell, and Y. Bazilevs. “Isogeometric analysis: CAD, finite elements, NURBS, exact geometry and mesh refinement”. Comput. Methods Appl. Mech. Eng., 194(39-41), pp. 4135–4195 (2005).

[2] K. W. McAlister *et al.*: An experimental study of dynamic stall on advanced airfoil sections. NASA/TM-84245 (1982).