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EFFECT OF THE WIND TURBINE FLUID–STRUCTURE INTERACTION ON THE TOWER DESIGN

Michael C. H. Wu[1,*], Chenglong Wang[1], Dominik Schillinger[2], and Ming-Chen Hsu[1]

[1] Department of Mechanical Engineering, Iowa State University, Ames, IA 50011, USA
[*] mikechwu@iastate.edu
[2] Department of Civil, Environmental, and Geo- Engineering, University of Minnesota, Minneapolis, MN 55455, USA

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The aim of this work is to develop a computational technique to include the tower structural response in the wind turbine fluid–structure interaction (FSI) simulation framework, couple the loads between the tower and rotating rotor, and model the rotor–tower structural interaction. The rigid wind turbine rotor–tower aerodynamic interaction was successfully simulated and validated in Hsu et al. [1]. The study showed that the blade passing the tower produces an appreciable drop in the aerodynamic torque. This creates additional cyclic loading on the blades and the tower. Furthermore, the FSI modeling employed in Hsu et al. [2] captured the variability in the deformation of the individual blades as well as that of the aerodynamic torque during each revolution. Because the blade deformation and aerodynamic force are nonsymmetric at any instant in time, eccentric loads may be experienced on the hub and nacelle. This may be important to predict for the purposes of tower design. The FSI simulation proposed in this work will provide structural response of the tower in reaction to the wind and rotor, in a multi-physics, fully-coupled fashion.

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