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Fluid-Structure Interaction Simulations of a Parked Wind Turbine Rotor Blade under Steady and Unsteady Inflow Conditions ROBERT CAMPBELL, BALAJI JAYARAMAN, ADAM LAVELY, JAVIER MOTTA-MENA, GANESH VIJAYAKUMAR, Penn State University — Tightly coupled fluid-structure interaction (FSI) simulations are performed for an NREL 5 MW rotor blade in the parked configuration for steady and unsteady inflow conditions. The FSI solver employs a partitioned approach that couples OpenFOAM as the flow solver and an author-developed structural finite element solver. Sub-iterations are employed to ensure convergence of the flow and structural response every solution time step. The simulations are performed for the NREL 5 MW blade, with the structural response represented by a modal summation solution. A custom fluid mesh motion solver allows the fluid mesh motion to occur primarily in a region local to the blade, while maintaining the mesh quality near the blade surface. The time-accurate blade response allows the approximation of a linear structural model to be assessed for the NREL 5 MW blade. Details of the FSI solver, including the mesh motion scheme and solution times are presented. Comparisons of blade loadings for steady and unsteady inflow conditions demonstrate the importance of blade flexibility for these simulations. Supported by the US Department of Energy.

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