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Fluid-structure coupling for wind turbine blade analysis using OpenFOAM[1] BASTIAN DOSE, IVAN HERRAEZ, JOACHIM PEINKE, ForWind - Institute of Physics, University of Oldenburg — Modern wind turbine rotor blades are designed increasingly large and flexible. This structural flexibility represents a problem for the field of Computational Fluid Dynamics (CFD), which is used for accurate load calculations and detailed investigations of rotor aerodynamics. As the blade geometries within CFD simulations are considered stiff, the effect of blade deformation caused by aerodynamic loads cannot be captured by the common CFD approach. Coupling the flow solver with a structural solver can overcome this restriction and enables the investigation of flexible wind turbine blades. For this purpose, a new Finite Element (FE) solver was implemented into the open source CFD code OpenFOAM. Using a beam element formulation based on the Geometrically Exact Beam Theory (GEBT), the structural model can capture geometric non-linearities such as large deformations. Coupled with CFD solvers of the OpenFOAM package, the new framework represents a powerful tool for aerodynamic investigations. In this work, we investigated the aerodynamic performance of a state of the art wind turbine. For different wind speeds, aerodynamic key parameters are evaluated and compared for both, rigid and flexible blade geometries.

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