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Aerodynamic and Aeroacoustic Analysis of a Passive-Adaptive Slat for a Wind Turbine Airfoil[1] ZEINAB GHARIBI, JOACHIM PEINKE, ForWind-Centre for Wind Energy Research, Institute of Physics, University of Oldenburg, BERNHARD STOEVESANDT, Fraunhofer IWES, Institute for Wind Energy and Energy System Technology — This study presents results of numerical aerodynamic and aeroacoustic simulations on a reference airfoil DU 91-W2-250 combined with a passive-adaptive slat. The leading-edge slat was designed by German aerospace centre (DLR) as a part of the common German research project "Smart Blades II". An extended numerical aerodynamic analysis based on computational fluid dynamics (CFD) was performed in OpenFOAM. The studies were conducted for two slat configurations: open and closed conditions. Large Eddy Simulations (LES) in combination with Wall Adapting Local Eddy-viscosity (WALE) turbulence model were performed for various angles of attack for two different free stream velocities. Besides a detailed flow analysis, the physical flow mechanisms responsible for noise generation were identified. In the computation of far-field slat noise, unsteady flow data from LES models were extracted at a permeable surface in the near-field of the profile and used as input for FfowcsWilliams-Hawkings (FW-H) equations. The farfield noise spectra were characterised by narrow-band peaks, broadband noise and a single broad tone. The results were compared with experimental data, and quantitative agreement was obtained in terms of mean pressure distribution and the far-field noise spectra.

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