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A Computational Study of the Aerodynamics and Aeroacoustics of a Flatback Airfoil Using Hybrid RANS-LES

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This work compares the aerodynamic and aeroacoustic predictions for flatback airfoil geometries obtained by applying advanced turbulence modeling simulation techniques within Computational Fluid Dynamics (CFD) methods that resolve the Reynolds-Averaged Navier-Stokes (RANS) equations of motion. These flatback airfoil geometries are designed for wind turbine applications. Results from different CFD codes using hybrid RANS-LES and RANS turbulence simulations are correlated and include analysis with experimental data. These data comparisons include aerodynamic and a limited amount of aeroacoustic results. While the mean lift prediction remains relatively insensitive across many simulation techniques and parameters, the mean drag prediction is dependent on both the grid and turbulence simulation method. Aeroacoustic predictions obtained from post-processing of the airfoil surface pressure agree reasonably well with experimental data when consistent boundary layer tripping is used for both the simulation and experimental configuration.