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Wind turbine airfoil investigations in customized turbulent inflow[1] HENDRIK HEISSELMANN, JOACHIM PEINKE, MICHAEL HOELLING, ForWind - Institute of Physics, University of Oldenburg — Experimental airfoil characterizations are usually performed in laminar or unsteady periodical flows. Neither of these matches the flow conditions of natural atmospheric flows as experienced by wind turbine blades. In the presented experimental study, an active grid is used to generate turbulent inflow with customized properties, like reduced frequencies or inflow angles. This is used not only to tune flow properties, but also to mimic time series of measured atmospheric wind speeds and inflow angles in the wind tunnel. Experiments were performed on a wind turbine dedicated DU 00-W-212 airfoil to obtain highly resolved force data and chord-wise pressure distributions at Re=500,000 and Re=900,000. Additional to a laminar baseline case, unsteady sinusoidal inflow fluctuations were applied as well as three different turbulent inflows with comparable turbulence intensity, but different inflow angle fluctuations to grasp the impact of inflow characteristics on the airfoil performance. In comparison with the laminar inflow case, the lift peak of the polar is shifted to higher angles of attack in the turbulent flows. While the laminar lift polars show a rather sudden transition to stall, a softer transition with an extended stall region is found for all turbulent cases.

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