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Effect of Free-stream Turbulence on Flow Separation in S809 Wind Turbine Blade[1] SHEILLA TORRES-NIEVES, VICTOR MALDONADO, Rensselaer Polytechnic Institute, CHARLES MENEVEAU, The Johns Hopkins University, LUCIANO CASTILLO, Texas Tech University — Two-dimensional Particle Image Velocimetry (2D-PIV) measurements are performed to study the effects of free-stream turbulence on the flow around a smooth and rough surface airfoil, specifically under stall conditions. A 0.25-m chord model with an S809 profile, common for horizontal-axis wind turbine applications, was tested at a wind tunnel speed of 10 m/s, resulting in Reynolds numbers based on the chord of 182,000 and turbulence intensity levels of up to 6.14%. Analysis of the mean flow over the suction surface shows that, contrary to what is expected, free-stream turbulence is actually advancing separation, particularly when the turbulent scales in the free-stream are of the same order as the chord. This behavior is also confirmed by the examination of the aerodynamic coefficients; under stall conditions, the aerodynamic performance is slightly improved, from L/D 1.696 to 1.787. Further analysis of mean and turbulent quantities in the flow field will be performed in order to understand the mechanism by which free-stream turbulence is advancing separation.

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