Abstract Submitted
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Numerical study of the Interaction between Nonsteady Transition and Separation on Oscillating Airfoils[1] TARAK NANDI, BALAJI JAYARAMAN, ADAM LAVELY, GANESH VIJAYAKUMAR, The Pennsylvania State University, ERIC PATERSON, Virginia Tech, JAMES BRASSEUR, The Pennsylvania State University — Strong correlation between vertical and horizontal turbulent motions in a daytime atmospheric boundary layer can produce $> 50\%$ variability in local angle of attack(AoA) on commercial wind turbine blade sections. Lee and Gerontakos(JFM 2004)reported an unique experiment where nonsteady transition and boundary layer(BL) separation were estimated on an oscillating airfoil at $Re \sim 10^5$ and reduced frequencies upto 0.2. We use the $k-\omega$ SST URANS model and the $\gamma - Re_\theta$ transition model to explore the predictive capability of these models,and to study the dynamic interactions between transition and separation on an oscillating airfoil with focus on the 3D time-dependent BL characteristics. The calculations are done in OpenFOAM on a wing section of aspect ratio 1 and periodic spanwise boundary conditions. Grid resolution analysis shows that 6M cells are required to resolve the viscous sublayer and capture separation. Fixed AoA cases show good lift comparison but the transition model performs better at higher AoA's when separation-induced transition occurs;fully turbulent URANS mispredicts separation and lift. Prediction of the oscillating cases show differences with experiment in hysteresis loops of the force coefficients. These and related issues will be discussed.

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