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Coriolis effect on dynamic stall in a vertical axis wind turbine[1]
HSIEH-CHEN TSAI, TIM COLONIUS, California Institute of Technology — The immersed boundary method is used to simulate the flow around a two-dimensional rotating NACA 0018 airfoil at moderate (sub-scale) Reynolds number in order to investigate separated flow occurring on a vertical-axis wind turbine (VAWT). The influence of dynamic stall on the forces is characterized as a function of tip-speed ratio. The influence of the Coriolis effect is also investigated by comparing the rotating airfoil to one undergoing a surging and pitching motion that produces an equivalent speed and angle-of-attack variation over the cycle. While the Coriolis force produces only small differences in the averaged forces, it plays an important role during dynamic stall. Due to the fact that the Coriolis force deflects the fluid and propagates the vortices differently, the wake-capturing phenomenon of the trailing edge vortex is observed in the flow around the rotating airfoil during a certain range of azimuthal angle. This wake-capturing of the trailing edge vortex leads to a large decrease in lift. However, because of the phase difference between each wake-capturing, there are only small differences in the average forces. The simulations are also compared to results from companion water-tunnel experiments at Caltech.

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