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Dynamic Separation on a Pitching and Surging Airfoil as a Model for Flow over Vertical Axis Wind Turbine Blades[1] REEVE DUNNE, BEVERLEY MCKEON, California Institute of Technology — The flow over a pitching and surging NACA 0018 airfoil at a chord Reynolds number of 100,000 is investigated using 2D time resolved particle image velocimetry. Sinusoidal pitch experiments between $\pm 30^\circ$ at a reduced frequency $k = \frac{\Omega c}{2U_\infty} = .12$ closely simulate the unsteady angle of attack experienced by the blade of a representative commercial vertical axis wind turbine (VAWT). The unsteady separation process is analyzed in detail with a focus on development of vorticity at the leading edge. Reduced order modeling techniques are used to deconstruct the flow and identify the evolution of dominant flow structures over the pitching cycle. Surging at the same reduced frequency and $\frac{U_{max}-U_{min}}{U_{mean}} = .80$ is added to investigate the effect of the Reynolds number variation associated with the rotation of a VAWT blade in a non-rotating, laboratory frame.

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