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Vortex shedding from vertical axis wind turbine blades under linear motion[1] REEVE DUNNE, BEVERLEY MCKEON, California Institute of Technology — A NACA 0018 airfoil was pitched and surged sinusoidally in in a mean free stream flow at $\mathrm{Re_c} = 100,000$ to simulate the flow over vertical axis wind turbine (VAWT) blades. Angle of attack variations between $\alpha = \pm 30^\circ$ and velocity variation of $\frac{\mathrm{U_{max}} - \mathrm{U_{min}}}{\mathrm{U_{mean}}} = .80$ at a reduced frequency $\mathrm{k} = \frac{\Omega \mathrm{c}}{2\mathrm{U}_\infty} = .12$ result in strong dynamic stall on the blade. Multiple flow regimes occur during the airfoil motion resulting in vortex shedding over a large range of frequencies. A model of the phase averaged (based on airfoil angle of attack and velocity) flow developed using dynamic mode decomposition highlights the evolution of the leading edge or dynamic stall vortex at the airfoil frequency. Instantaneous results show vortex shedding at frequencies up to 100 times higher than the frequency of the pitch/surge motion and smeared out by the phase averaging process. The implications for forcing on the blade (and associated wind turbine) are described.

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