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Examining Dynamic Stall for an Oscillating NACA 4412 Hydrofoil[1] ERIC MCVAY, AMY LANG, University of Alabama, LAWREN GAMBLE, Smith College, MICHAEL BRADSHAW, University of Alabama — Dynamic stall is unsteady separation that occurs when a hydrofoil pitches through the static stall angle while simultaneously experiencing a rapid change in angle of attack. The NACA 4412 hydrofoil was selected for this research because it has strong trailing edge turbulent boundary layer separation characteristics. General dynamic stall angle of attack for approximately symmetric airfoils has been recorded to occur at 24 degrees, with separation beginning at about 16 degrees. It is predicted that the boundary layer will stay attached at a higher angle of attack because of the cambered geometry of the hydrofoil. It is also hypothesized that the boundary layer separation occurs closer to the trailing edge and that the dynamic stall angle of attack occurs somewhere between 24 and 28 degrees for the oscillating NACA 4412 hydrofoil. This research was conducted in a water tunnel facility using Time Resolved Digital Particle Image Velocimetry (TR-DPIV). The hydrofoil was pitched up from 0 to 30 degrees at Reynolds numbers of 60,000, 80,000 and 100,000. Flow characteristics, dynamic stall angles of attack, and points of boundary layer separation were compared at each velocity with both tripped and un-tripped surfaces. Follow-on research will be conducted using flow control techniques from sharks and dolphins to examine the potential benefits of these natural designs for separation control.

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