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Separation Control on a Hydrofoil Using Leading Edge Protuberances[1] DERRICK CUSTODIO, Worcester Polytechnic Institute, CHARLES HENOCH, Naval Undersea Warfare center, Newport, RI, HAMID JOHARI, Worcester Polytechnic Institute, WORCESTER POLYTECHNIC INSTITUTE COLLABORATION, NAVAL UNDERSEA WARFARE CENTER COLLABORATION — The humpback whale's maneuvarability has been attributed to their use of pectoral flippers, on which protuberances are present along the leading edge. To examine the effects of protuberances on hydrofoil performance, the lift, drag, and pitching moments of two-dimensional hydrofoils with leading edge sinusoidal protuberances were measured in a water tunnel and compared to those of a baseline NACA 63(4)-021 hydrofoil. The amplitude and spanwise wavelengths of the protuberances ranged from 2.5% to 12% and 25% to 50% of the mean chord length respectively. Flow visualizations using tufts and dye, as well as Laser Doppler Velocimetry (LDV) measurements were performed to examine the flow patterns surrounding the hydrofoils. At angles of attack lower than the stall angle of the baseline, the modified foils revealed lower lift and increased drag. However, above this angle the lift generated by the modified foils was up to 50% greater than the baseline foil with little or no drag penalty. The amplitude of the protuberances has a large effect on the performance of the hydrofoils whereas the wavelength has little. Flow topology on the protuberances will be discussed by means of the visualization and measured velocities.

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