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Flow Field Characteristics of Finite-span Hydrofoils with Leading Edge Protuberances[1] DERRICK CUSTODIO, Worcester Polytechnic Institute, CHARLES HENOCH, Naval Undersea Warfare Center, Newport, RI, HAMID JOHARI, California State University, Northridge, OFFICE OF NAVAL RESEARCH COLLABORATION — Past work has shown that humpback whale-like leading edge protuberances can significantly alter the load characteristics of both 2D and finite-span hydrofoils. To understand the mechanisms responsible for observed performance changes, the flow field characteristics of a baseline hydrofoil and models with leading edge protuberances were examined using the Stereo Particle Image Velocimetry (SPIV) technique. The near surface flow field on the hydrofoils was measured along with the tip vortex flow field on finite-span hydrofoils. Angles of attack ranging from 6 to 24 degrees were examined at freestream velocities of 1.8 m/s and 4.5 m/s, corresponding to Reynolds numbers of 180 and 450 thousand, respectively. While Reynolds number does not play a major role in establishing the flow field trends, both the protuberance geometry and spatial proximity to protuberances affect the velocity and vorticity characteristics near the foil surface, and in the wake and tip vortex. Near surface measurements reveal counter-rotating vortices on protuberance shoulders, while tip vortex measurements show that streamwise vorticity can be strongly affected by the presence of protuberances. The observed flow field characteristics will be presented.

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