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Identification of Large Scale Structures in the Wake of Cavitating Hydrofoils Using LES and TR-PIV[1] MARTIN WOSNIK, QIAO QIN, ROGER E.A. ARNDT, University of Minnesota — Large-scale three-dimensional cavitating structures exist in the wake of two-dimensional hydrofoils, as a result of sheet/cloud cavitation. This type of cavitation produces unsteady lift on most hydrofoils – including the NACA 0015 studied here – but is sufficiently periodic to have potential for control. A Large Eddy Simulation (LES) based on a virtual single-phase, fully compressible cavitation model captures the complex dynamical features of this highly unsteady cavitating flow well. The LES results are compared to Time-Resolved Particle Image Velocimetry (TR-PIV, recorded at 2000Hz) in the region immediately downstream of the hydrofoil, with particular attention to the predicted vortex shedding mechanisms. With a careful choice of photometric parameters and adaptive masking, the large, vortical, cavitating structures are identified quantitatively. The existence of the primary vortex pair predicted by the LES is confirmed by TR-PIV. This vortex pair produces large cross-stream velocities, with a general ejection direction of $3/4\pi$ to the free stream. However, the shedding pattern as recorded with TR-PIV is not nearly as regular as in the LES, due to the limited number of spanwise grid points in the simulation and the highly three- dimensional nature of cloud cavitation shedding in the experiment.

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