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An investigation of the dynamics of marine propeller tip vortices using large-eddy simulations[1] SETH SCHROEDER, ELIAS BALARAS, The George Washington University — The ability to capture the dynamics of tip vortices, which are generated by marine propellers, is of major interest to naval hydrodynamics designers. The tip vortex of a propeller has a direct impact on performance and acoustics. Additionally, the tip vortex is a major source of erosion damage on downstream components such as rudders and stators. In the present study we utilize large-eddy simulations to compute the flow around a generic, 7-bladed, right-handed submarine propeller in open water testing configuration. We considered three different advance coefficients at Reynolds number (based on the radius and advance speed) of the order of 300,000. The governing equations are discretized on a structured grid in cylindrical coordinates and the boundary conditions on the surface of the propeller, which is not aligned with the grid lines, are introduced using an immersed boundary method. Approximately 1 billion points is used in the computation box. Tip vortices are identified by low pressure areas and the second invariant of the velocity gradient tensor (Q-criterium). In general, the vortex core radius contracts with the acceleration in the wake, and then maintains a constant radius for a certain distance before becoming unstable. Stability is affected by the advance ratio.

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