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Large Eddy Simulation of Ducted Propulsors in Crashback
HYUNCHUL JANG, KRISHNAN MAHESH, University of Minnesota — Flow around a ducted marine propulsor is computed using the large eddy simulation methodology under crashback conditions. Crashback is an operating condition where a propulsor rotates in the reverse direction while the vessel moves in the forward direction. It is characterized by massive flow separation and highly unsteady propeller loads, which affect both blade life and maneuverability. The simulations are performed on unstructured grids using the algorithm developed by Mahesh et al. (2004, J. Comput. Phys 197). The flow is computed at the advance ratio $J=-0.7$ and Reynolds number $Re=480,000$ based on the propeller diameter. Average and RMS values of the unsteady loads such as thrust, torque, and side force on the blades and duct are compared to experiment. It is seen that even though effects of the duct on thrust and torque are not large enough, those on the side force are significant. The rms of side forces is much higher in the presence of the duct. Pressure distributions on blade surfaces and duct surface are examined and used to explain this effect. This work was supported by the United States Office of Naval Research under ONR Grant N00014-05-1-0003.

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