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Large-eddy simulation of propeller wake at design operating conditions[1] PRAVEEN KUMAR, KRISHNAN MAHESH, University of Minnesota — Understanding the propeller wake is crucial for efficient design and optimized performance. The dynamics of the propeller wake are also central to physical phenomena such as cavitation and acoustics. Large-eddy simulation is used to study the evolution of the wake of a five-bladed marine propeller from near to far field at design operating condition. The computed mean loads and phase-averaged flow field show good agreement with experiments. The propeller wake consisting of tip and hub vortices undergoes streamtube contraction, which is followed by the onset of instabilities as evident from the oscillations of the tip vortices. Simulation results reveal a mutual induction mechanism of instability where instead of the tip vortices interacting among themselves, they interact with the smaller vortices generated by the roll-up of the blade trailing edge wake in the near wake. Phase-averaged and ensemble-averaged flow fields are analyzed to explain the flow physics.

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Praveen Kumar
University of Minnesota

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