Open Water Propeller Performance

Project 2

Handed out: **October 28**
Due in: **November 11**

We will determine the performance of a propeller operating in open water. The propeller is a four-bladed stock propeller from the UM Marine Hydrodynamics Laboratory UM23. It is a four bladed propeller. An image is shown in figure 1. The propeller diameter is 0.128 m, and the $P/D = 1.08$.

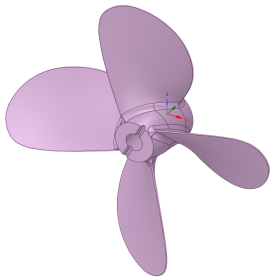

FIGURE 1. UM23 Propeller

A case is provided for you in the class github repository. Use the `pimpleFoam` solver for unsteady simulations. Compute the flow at three values of the advance coefficient, $J = 0.5, 0.7, 0.9$.

Perform a grid refinement study for $J = 0.7$. Thus you will have four total computations included in your results.

Your report is limited to 3 pages. Please be thorough in your write-up and use graphs judiciously. Formatting is very important to clearly communicate your results. Include the following components in your report:

Computational Setup: Discuss the solver that you used and the grid parameters like the total cell count and near-wall spacing (y^+). State the boundary conditions that you use on the inlet for the velocity and turbulence variables.

K_T, K_Q, and η_0: Plot the thrust, torque, and efficiency and compare with the experimental data that is provided.

Flow Field: Plot the pressure on the front and back of the propeller for each of the three values of J. Show the velocity field and vortex structure for each value of J. See the paper [1] for inspiration on generating figures.

REFERENCES

[1] R. Muscari, A. D. Mascio, R. Verzicco, Modelling of vortex dynamics in the wake of a marine propeller, Computers & Fluids (2012).