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OPEN-WATER COMPUTATIONS OF A MARINE PROPELLER USING OPENFOAM

Tuomas Turunen[1], Timo Siikonen[1], Johan Lundberg[2] and Rickard Bensow[3]

[1] Aalto University, School of Engineering, PO Box 14400, Sähkömiehentie 4, FI-00076 Aalto, tuomas.aarre.turunen@gmail.com

[2] Rolls-Royce, Varnumsleden 5, 68193 Kristinehamn, Sweden, johan.lundberg@rolls-royce.com

[3] Chalmers University of Technology, Dept. Shipping and Marine Technology, 41296 Göteborg, Sweden

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The flow around a marine propeller is studied by means of a RANS-type finite-volume (FV) method. A performance curve in open-water conditions is reproduced computationally and compared to data measured in a cavitation tunnel at Rolls-Royce in Kristinehamn, Sweden, see Fig. 1.

In the computations, both periodic grids with a single propeller blade and grids featuring a full propeller with five blades are used. Two types of full propeller grids are applied. The first one consists of tetrahedral control volumes with prismatic layers near the propeller surface. The second grid type is a hybrid mesh that is a combination of separately meshed hexahedral and tetrahedral grids with an Arbitrary Mesh Interface (AMI) between the two parts.

Turbulence is modelled by the two-equation SST k-ω model [1] as implemented in `OpenFOAM` [2]. In steady-state computations, the Moving Reference Frame (MRF) approach is applied to account for the effects due to rotation.

Effects due to time discretization are evaluated in the case of the backward and the Euler schemes. Both the effect of the truncation error and the iterative error due to an insufficient number of iterations inside a time step are studied. Their influence on global propeller forces and on propeller wake fields are analyzed separately.

This study provides a solid basis for more complicated simulations by providing an understanding of numerical errors caused by a finite grid, grid interfaces and the choice of discretizations of the governing equations. In particular, the experiences with the AMI methodology will allow the analysis of contra-rotating propellers (CRP) with `OpenFOAM`.

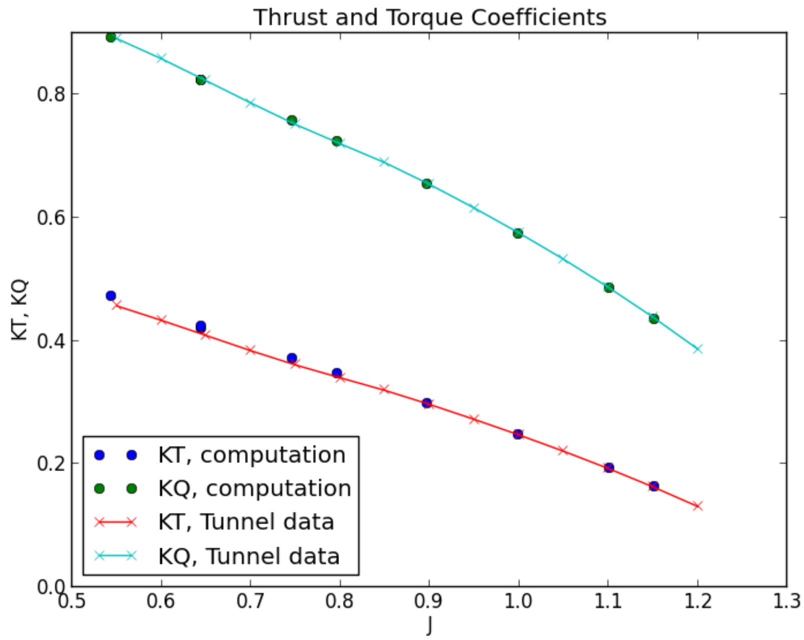

Figure 1: *Open water curve. The thrust and torque coefficients* K_T *and* K_Q *are compared against experimental data over a range of advance coefficient values* J*.*

In addition, the robustness of the numerical method is considered in order to be able to produce a usable tool for industrial use.

E-mail: *tuomas.aarre.turunen@gmail.com*

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