UNSTEADY HYDRODYNAMIC LOADS ON ENERGY SAVING DUCTS

Pascal Anschau*, Nikolai Kornev† and Sina Samarbakhsh†

† Chair of modeling and simulation, University of Rostock, Rostock, Germany
* Potsdam Ship Model Basin, Potsdam, Germany

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Energy saving devices (ESD) have proved to be a promising way to improve ship efficiency and to reduce ship emissions and costs of operation. In the present paper, the bulker model $M1749S030$ with ship lines, which are close to the JBC benchmark test, equipped with the Mewis Energy Saving Duct was studied both experimentally and numerically. Since the steady hydrodynamic interaction between ship hulls, duct and propeller has already been studied in the past, the attention was paid primarily to unsteady effects caused by the wake non uniformity and wake turbulence, which are still not considered in the literature. To resolve the unsteady effect, the hybrid simulation based on the decomposition of the solution into LES (far from the hull surface) and RANS (close to the hull) regions was applied. The resistance, propeller torque and thrust, pressure fluctuations at eight points on the duct and unsteady forces on the duct were measured in experiments.

Both numerical and experimental investigations show that (see further details in [1]):
• The spectrum of pressure pulsations has a pronounced peak in a low frequency region both in CFD and EFD with and without propeller. Its presence is due to the interaction between the duct and the incoming vortex structures shed from the hull.
• The propeller suction increases the magnitude of pressure oscillations and, consequently, unsteadiness of forces on the duct.
• The fluctuation of all three force components on the duct is essential both in design and ballast conditions. This is the most important conclusion of this work from the practical point of view. The root mean squares of the fluctuation of axial, transverse and vertical forces are, respectively 1.5, 0.8 and 0.4 percent of the total propeller thrust. Being multiplied with the cube of the scale factor λ for the real scale, these fluctuations point out on big amplitudes of unsteady forces which should be considered in structural analysis of ESD.

REFERENCES

[1] Anschau, P., Kornev, N., and Samarbakhsh, S. Unsteady Hydrodynamic Loads on Energy Saving Ducts. *Ocean Engineering, in press* (2022).