Validation and Applications of Immersed RANS-RANS Coupling

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ABSTRACT

Enabled by enhanced computational capabilities the complexity of the maneuvering simulation scenarios is increasing steadily. Whereas simple guided-hull maneuvers like zig-zag simulations were previously deemed advanced, a demand to simulate maneuvers with all acting devices like propellers, rudders and transverse thrusters simultaneously is seen nowadays [1].

During these maneuvers the propellers do not operate in design conditions which leads to detached flows and other nonlinear phenomena. Therefore, potential flow methods cannot be used. When modeling a vessel with multiple propulsors using established techniques like overset grids or sliding interfaces to represent the propellers rotation, a fairly small the time step size has to be chosen. This leads to a huge effort as the maneuver's duration refers to a significantly larger timescale.

The present immersed RANS-RANS coupling combines different RANS models for ship and propeller and can be placed between high fidelity approaches like sliding interfaces and the simple moving frame of reference (MRF) approach [2]. Simulating the propeller at a smaller timestep than the vessel ensures stable simulations, even with highly disturbed, transient inflow conditions and facilitate faster simulations due to a larger global timestep.

The focus of this presentation will be on the validations of the method and the implementation of strategies for an adequate coupling of the turbulence treatment. The presentation will finish with some sample applications.

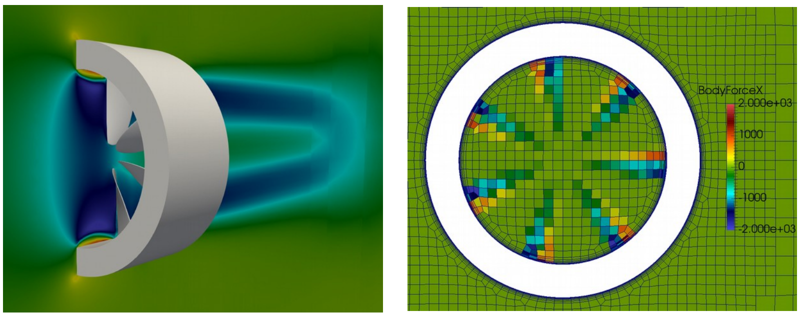

Figure 1: The left figure shows a RANS simulation of a transverse thruster. On the right the resulting immersed bodyforces can be seen.

REFERENCES

[1] P.M. Carrica, A.M. Castro & F. Stern, "Self-propulsion computations using a speed controller and a discretized propeller with dynamic overset grids", *J Mar Sci Technol*, Vol 15, pp. 316-330, (2010).

[2] M. Nuutinen and P. Miettinen, "Dynamic versus static CFD of Azipod oblique flow hydrodynamic loads", *smp'17 Espoo, Finland* (2017).