MSc. Thesis Proposal

Title: CFD analysis of ship resistance in very shallow water

Supervisors
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Introduction
Motivation
In ports, rivers, canals or near-shore, ships are often operating in shallow water conditions. A shallow water depth can have various detrimental effects on the vessel, including increase of resistance/velocity reduction, increase of draft (squat) and reduced maneuverability. Knowledge and estimation of those effects is important to maintain a safe navigation in confined waters.
Traditionally, quantification of such behavior typically relied on scale model tests or real-world measurements, based on which empirical, parametric models were developed. Examples can be found in the Recommended Practices and Guidelines by the International Towing Tank Conference (ITTC) or standards of classification societies. Meanwhile, the applicability of parametric models is often limited to certain operational scenarios and ship types.

Existing work
Nowadays, the advancement in High-Performance-Computing allows to assess test-case and ship-type specific numerical analysis by means of Computational Fluid Dynamics (CFD). In the scope of this thesis, a resistance analysis of an electric ferry operating in a shallow-water harbor shall be performed using CFD code ReFRESCO[1]. The community-based open-usage software is developed by Marin (www.marin.nl) together with blueOASIS (www.blueoasis.pt) specifically with maritime problems in mind. Results from the CFD analysis are to be compared to parametric approaches.
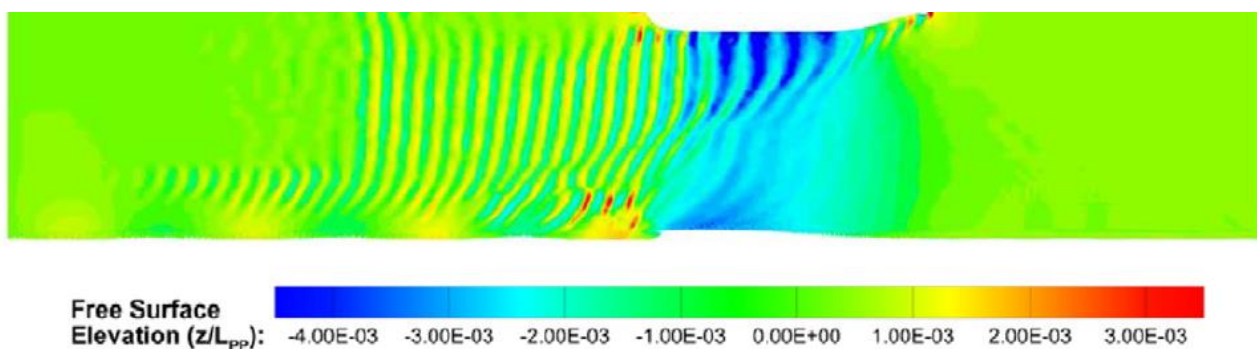

Free Surface Elevation (z/L_{PP}): -4.00E-03   -3.00E-03   -2.00E-03   -1.00E-03   0.00E+00   1.00E-03   2.00E-03   3.00E-03

Figure 1: Wave pattern in confined water

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[1] https://www.marin.nl/en/facilities-and-tools/software/refresco ,
ResearchGate: https://www.researchgate.net/project/ReFRESCO-A-open-usage-multi-phase-viscous-flow-CFD-code-for-the-Maritime-World
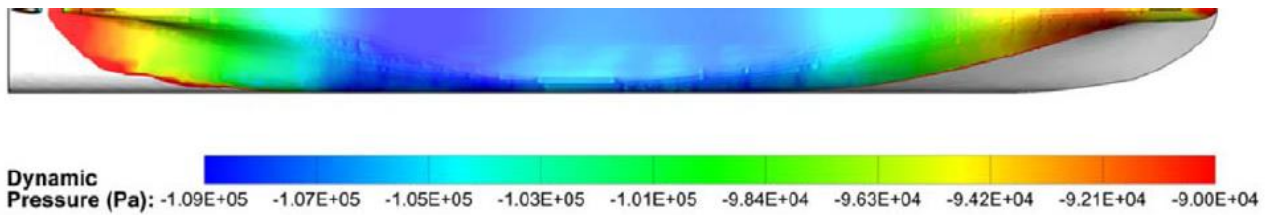
Figure 2: Dynamic pressure distribution on bottom of ship hull

Objectives

In particular, the following studies are planned to be performed:

- Literature study on ship resistance in shallow water.
- Get familiar with using CFD code ReFRESCO.
- Setting up the test cases, determining suitable numerical settings (boundary conditions, use of wall functions or viscous layers, …).
- Compile the resistance curve for a selection of different water depths and ship speeds.
- Conducting shallow water correction according to ITTC methodology.
- Comparing CFD output with ITTC results and literature.
- Reporting and presentation. Upon good performance of the candidate the work may be presented in a conference and/or in a journal.

Requisites

Applicants must have:

- General knowledge of CFD
- Coding experience with Python or similar

Good to have:

- Linux experience
- LateX experience
- Knowledge on ship resistance and propulsion.

Location

blueOASIS (www.blueoasis.pt) Edificio D.Pedro, Quinta da Fonte, R. Malhões, 2770-071 Lisboa The student is invited to join the team in the office when the supervisor is present (at least three days per week).

Companies Involved

blueOASIS is a young team with more than 45 years of combined knowledge and experience on Aerospace, Mechanical, Naval and Maritime engineering. The multicultural and multidisciplinary team is committed to make our oceans safer and greener, using state of the art numerical and data science tools. BlueOASIS focuses on renewable energies, ocean cleaning, decarbonization, sustainable offshore structures and green ships optimization.

Bibliography

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