BETTER SHIPS, BLUE OCEANS

Master thesis proposal, June 2024

Title: **Generation of synthetic turbulent wakes**

Supervisors: Maarten Kerkvliet (MARIN), Artur Lidtke (MARIN), Philip Ströer (U. Twente)

Duration: A minimum of nine months, starting in late 2024

Candidate profile:

The candidate should have a background in a relevant discipline, such as engineering or computer science, preferably with an interest in turbulence. Rudimentary theoretical and practical knowledge of computational fluid dynamics (CFD) is preferred, with experience in using Linux being desirable. At least basic programming skills in a scripting language (Python, Matlab) are a must.

Description:

Ship propellers operate in strongly non-uniform turbulent flows generated by the hull, which has a significant influence on hydrodynamic performance and the risk of noise and cavitation. Accounting for the inflow is therefore of key importance for propeller design, but is challenging to do without including the complete ship geometry in the simulations, leading to prohibitive computational costs. To minimize costs, synthetic inflow turbulence generators are used to artificially replicate the wake produced by the ship's hull without simulating the hull itself.

The proposed project will investigate realistic wakefield generation for unsteady simulations using the inflow turbulence generator (ITG) method. Particular care will be applied to achieving accurate prediction of mean and fluctuating velocity components, as well as turbulent length scales. To this effect, the method will need to be extended and improved using the most recent advances in this field of research. To achieve this, the wake downstream of a sphere will be used as a surrogate model for the wake of the hull (Fig. 1).

Successful improvement of the ITG method would lead to much reduced computational costs for scale-resolving propeller simulations, paving the way to including such high-fidelity computations in the design cycle of a propeller. The wake downstream of a sphere will be considered as a surrogate model for the wake of the hull.

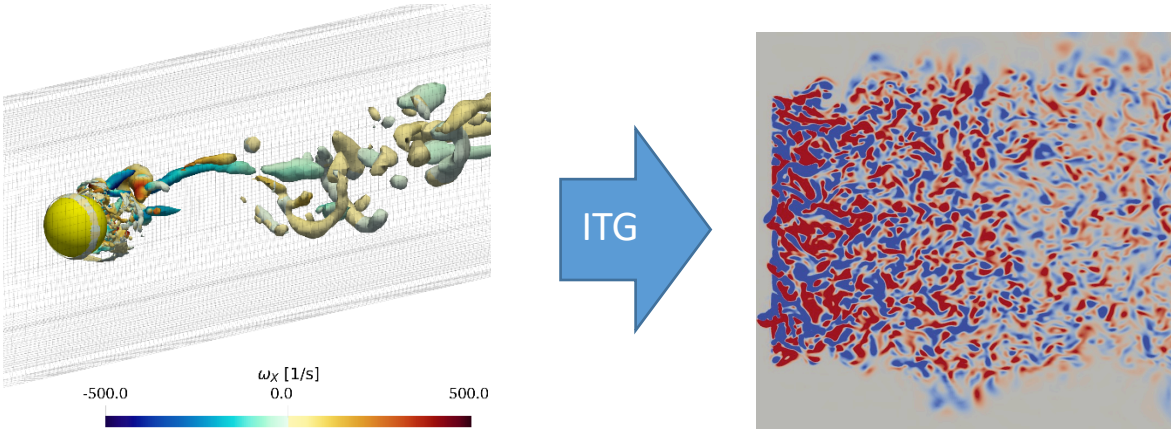

Figure 1: Illustration of the core idea of the project – results of high-fidelity turbulent wake data for a sphere would be used in order to create inputs and test data for the ITG method. The methodology would then be extended to better capture the turbulence characteristics. The ultimate aim is producing realistic inflow conditions for complex propeller simulations.

BETTER SHIPS, BLUE OCEANS

Master thesis proposal, June 2024

The following primary tasks are envisaged:

- Analysis of the wake database.
- Setting up a CFD simulation serving as an environment for testing and evaluation of the ITG.
- Literature review, particularly synthetic turbulence generation methods.
- Extension of the ITG method by modifying the current source terms or implementing a new approach.
- Analysis, interpretation and reporting of results, in the form of a thesis and paper(s).

During the project, the student is expected to spend a proportion of time at the Maritime Research Institute Netherlands (MARIN) in Wageningen. A bursary is available to cover subsistence costs.

Contact: Artur Lidtke (a.lidtke@marin.nl), Philip Ströer (p.stroer@utwente.nl).