MSc thesis project 2022 on the Division of Marine Technology
Department of Mechanics and Maritime Sciences
Chalmers University of Technology

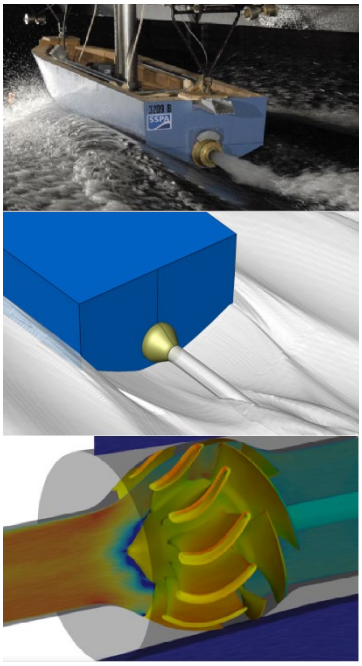
The Hydrodynamics of Electric Waterjet Propulsion

Background

Waterjet propulsion systems have specific characteristics that can make them a better choice than conventional marine propellers, including higher achievable service speed and better manoeuvrability. Waterjets are quieter in comparison to propellers and produce less vibration and noise, improving not only passenger comfort levels but also underwater noise and vibration can be reduced by more than 50%. Today, diesel engines often power modern waterjet units. The installation of waterjet propulsion units and their intake design are constrained by the size of the engine and the gearbox.

Objective

The application of electric drives can reduce the dictated constraints of the conventional waterjet units and thus open new opportunities for modifying the placement of the waterjet unit, the intake design, and the waterjet pump's design. The main objective of this project is to enhance the performance of the conventional waterjet systems by utilizing electric drives resulting in reduced CO2 emissions as well as the noise generated by the propulsion system.



Waterjet self-propulsion tests at SSPA (top) and self-propulsion simulation (middle) and pump flow (bottom) using RANS.

Methods and tools

The project will primarily focus on the hydrodynamic design of a new intake for electric waterjet propulsion unit, which also requires modification of hull design suitable for electric waterjet propulsion. A parametric model will be developed for the intake of an electric waterjet unit which does not have the restrictions of a diesel engine powered unit. The parametric models enable modification of the intake geometry for optimising the design criteria, which are increased boundary layer ingestion to the intake, reduced intake losses and uniformity of the flow into the pump. The flow inside the new waterjet will be analysed using a Reynolds-Averaged Navier-Stokes (RANS) based method in STAR-CCM+.

Miscellaneous

The division of Marine Technology at Chalmers has a close collaboration with Kongsberg Maritime in Sweden (manufacturer of Kamewa waterjets). The students working on the project will receive feedback on their work from waterjet experts at the company.

Prerequisites

- Background in Mechanical Engineering, Naval Architecture, or similar
- Familiarity with Computer Aided Design tools (e.g. CAESES)
- Knowledge and interest in Computational Fluid Dynamics

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