CHALMERS
MECHANICS AND MARITIME SCIENCES

October 23, 2018

R.E. Bensow

Master thesis project:

Variable resolution PANS for submarine simulations

Background

More and more, transient flow effects are considered in design of all kinds of vessels or vehicles. In these cases, a RANS methodology is not appropriate while an LES often is too demanding. To fill this gap, there has been extensive research and development on hybrid RANS/LES methods, where DES is the most known and used approach. An alternative is the less mature approach of PANS, Partially averaged Navier-Stokes, approach, which promises to avoid several of the problems of DES.

Ship simulations is a particularly demanding flow, as there is a long developing boundary layer along the ship hull ending in weak separation or vortex generation towards the stern. In this project, a submarine model will be used to test PANS approaches, see figure below. The hull is a test case in a NATO AVT working group, where this work will contribute with simulation results, and the results will be compared with both experimental data as well as several other CFD results.

Objective and method

An existing OpenFOAM implementation of a PANS version based on the k-ω model will be expanded to account for variable resolution in the filter function. The new implementation will be validated for both bluff body flows and boundary layer flows.

Thereafter, the model will be applied to the BB2 generic submarine model for both straight flight and 10° yaw. PANS results, with fixed filter and the new variable filter version, should be compared with RANS results as well as results from other participants in the working group, including experiments.

Miscellaneous

The master thesis project is 30 credits and suitable for one-two students.

Prerequisites

- Background in Mechanical Engineering, Naval Architecture, or similar
- Knowledge and interest in computational fluid dynamics

Contact

Rickard Bensow, email: rickard.bensow@chalmers.se (Supervisor and examiner)