Shape optimization of a ship based on CFD simulations

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This presentation addresses the shape optimization of a monohull fishing vessel for multi-objective purpose - resistance and sea keeping ? including extensive Computational Fluid Dynamics (CFD) calculations with STAR-CCM+. Design variations, objectives and constraints are set up in collaboration with the naval architect.

To solve this problem, a complete optimization chain involving different tools as been developed, namely a CAD tool (Catia v5), a frequency-domain linear seakeeping code (Aqua+), two software tools with different levels of refinement for the ship resistance (potential and viscous flow codes (respectively Reva and STAR-CCM+), an optimisation environment (modeFRONTIER), and access to HPC (highly parallel computing) hardware.

Particular optimization strategies have been used to take into account the extensive CFD calculations, in particular a two-level optimization process. This led to a significant ship resistance reduction with reasonable sea keeping behaviour.

The present study shows how RANS methods can be used to calculate the ship resistance in a maritime industrial context. STAR-CCM+ results have been validated against experimental data (measured in towing tank) and showed an excellent accuracy. These methods can now be employed in comparison with basin tests for this type of study. They also can be of benefit within the optimization processes.

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