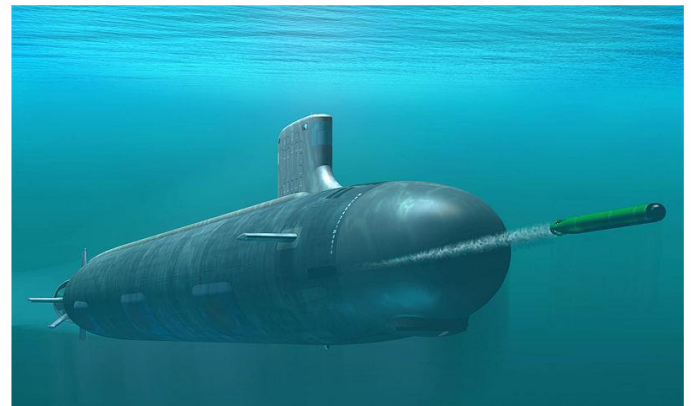




External hydrodynamics on a submarine

Objective

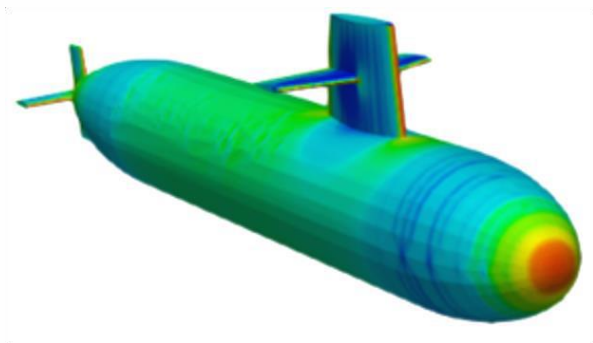
The design of submarines is of great importance, when it comes to the reduction of the hydrodynamic drag of the vessels and therefore improving its propulsive performance. The kiosk, a superstructure raised above the hull, is a very important hydrodynamics component. The connection between the hull and the kiosk, as well as the position of the latter, are very well-thought-out elements. The optimal design of the kiosk, however, depends on the navigation conditions (immersion, navigation in rough sea, maneuvering, emergency ascent, etc.), which makes the optimization of the design complex. In a context where scale 1 pool tests are generally impossible to carry out, digital simulation thus sets in as an essential tool in this design process. It is therefore with the objective of improving the hydrodynamics of the kiosk that Zelin has implemented its analytic capabilities in digital simulation.



Implementation

Zelin has set up a calculation process that's dedicated for modeling this type of flow:

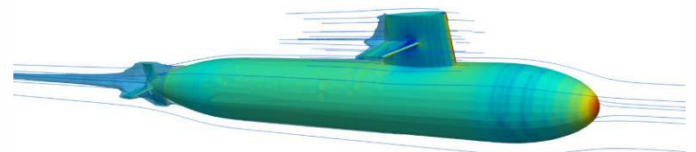
- 3D model of the submarine
- Material resources: HPC cluster (200 cores), Star CCM + and OpenFOAM codes
- Some analytic examples:
 - o Advanced mesh sensitivity (up to 5 million cells)
 - o Steady (RANS) and unsteady (URANS) approach
 - o Hydrodynamics assessment (drag, lift) on several navigation conditions
 - o Identification of turbulent structures in the wake of the kiosk



Result

The navigation sector has been widely explored to assess the effects of kiosk design on hydrodynamics. The identification of the most suitable shapes for the submarine on several navigation conditions allowed for a robust geometric optimization.

Through this external hydrodynamic study, Zelin was able to assess the sub-marine's control and stability performance, even during a maneuver. The simulation therefore improved the geometry of the vessel and guaranteed its propulsive performance.



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