Sviluppi della fluidodinamica CFD applicata alla progettazione

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30 marzo 2017 ore 16

FP1640985001
#Sharing3FVG

Webinar realizzato da IALFVG e parte degli 80 di #Sharing3FVG, progetto cofinanziato dal Fondo Sociale Europeo nell'ambito del Programma Operativo Regionale 2014/2020

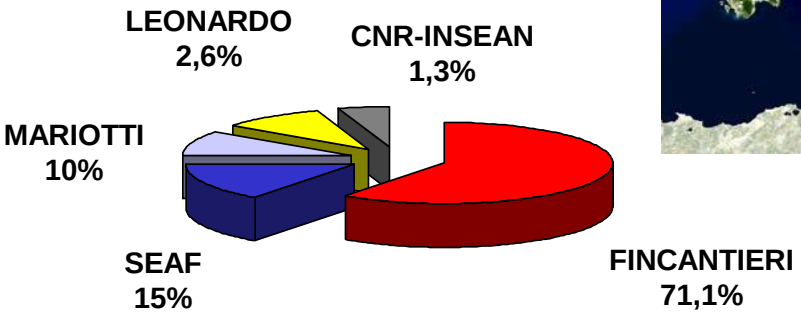
Who and Where we are

A company of the FINCANTIERI Group from 1962, dedicated to research & development in the marine field , consultancy, services and training for ship designers, shipbuilders, suppliers and maritime operators.

Main office in Genova

offices in: Trieste
Palermo
Muggiano
Castellammare
Ancona

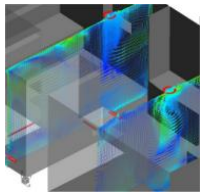
a **Workshop** in Riva Trigoso



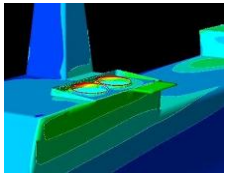
Staff: Different skills for a good team

- ✓ naval architects
- ✓ mechanical engineers
- ✓ electrical engineers
- ✓ physicists
- ✓ civil engineers
- ✓ philosopher
- ✓ chemical engineers
- ✓ IT engineer
- ✓ architects
- ✓ environmental scientist
- ✓ maritime economy expert
- ✓ technicians
- ✓ ship designers

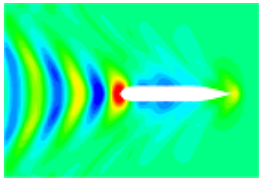
Main CFD activities



AIR CONDITIONING in public areas and cabins

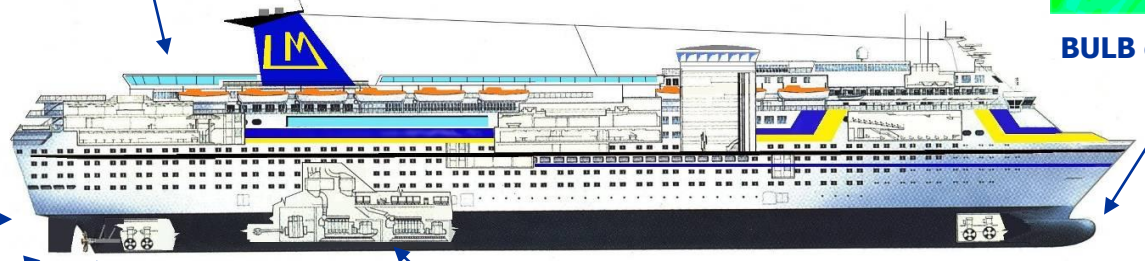


Optimisation of ship superstructures to reduce impact of exhaust gases and turbulence in passenger areas

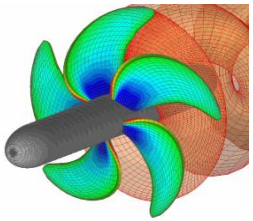


BULB optimisation

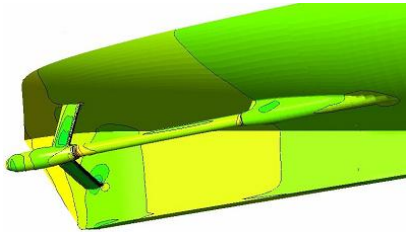
Position and design of RUDDERs and other manoeuvring devices



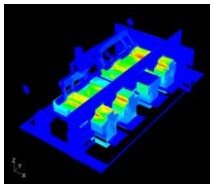
PROPELLER DESIGN to improve performance, reduce cavitation



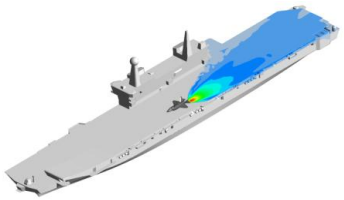
Optimisation of propeller APPENDAGES

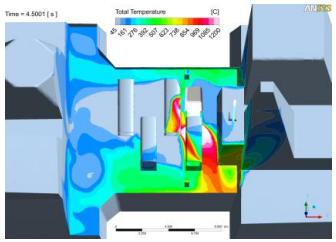


Engine room VENTILATION



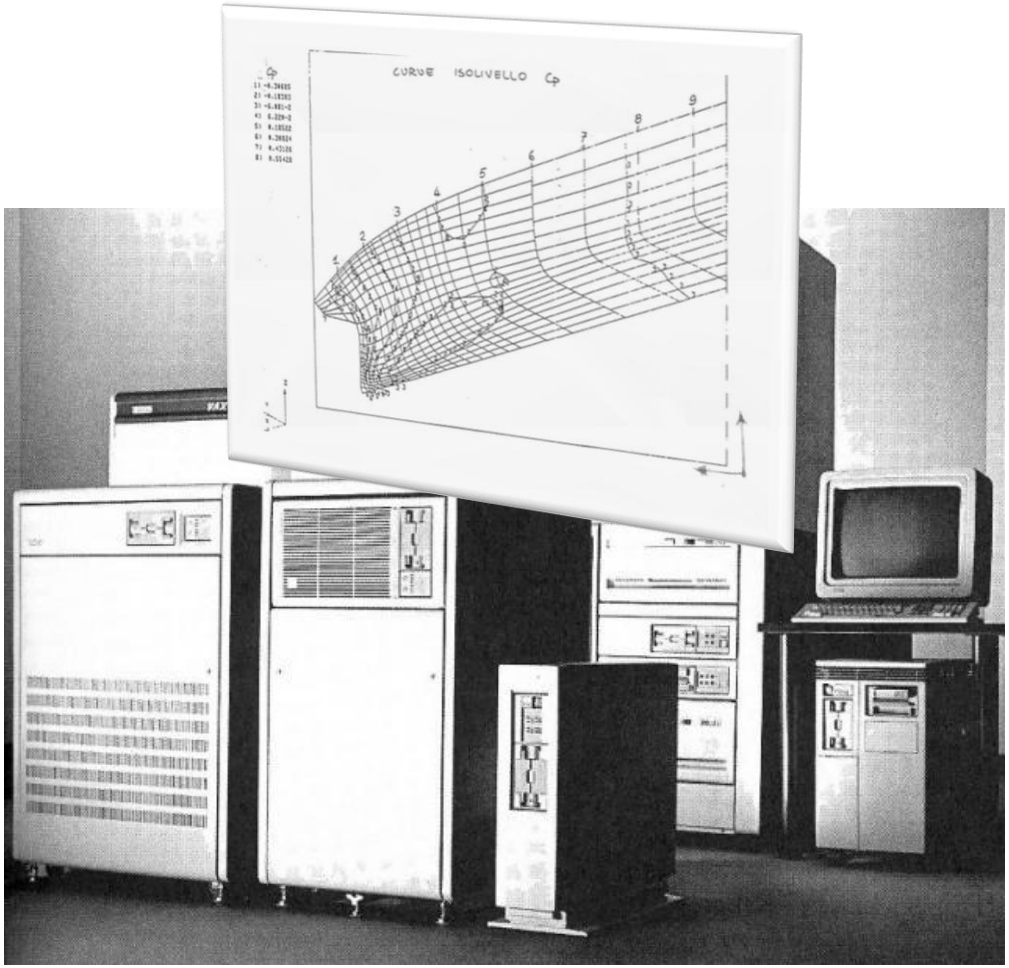
Thermal shock





Early CFD

- Cetena performs numerical simulations since the early '70
- Fortran codes
- Single purpose
- No graphical interface
- Output files ASCII
- Customizable I/O
- SW/User interaction



CFD codes boom in the ’90s

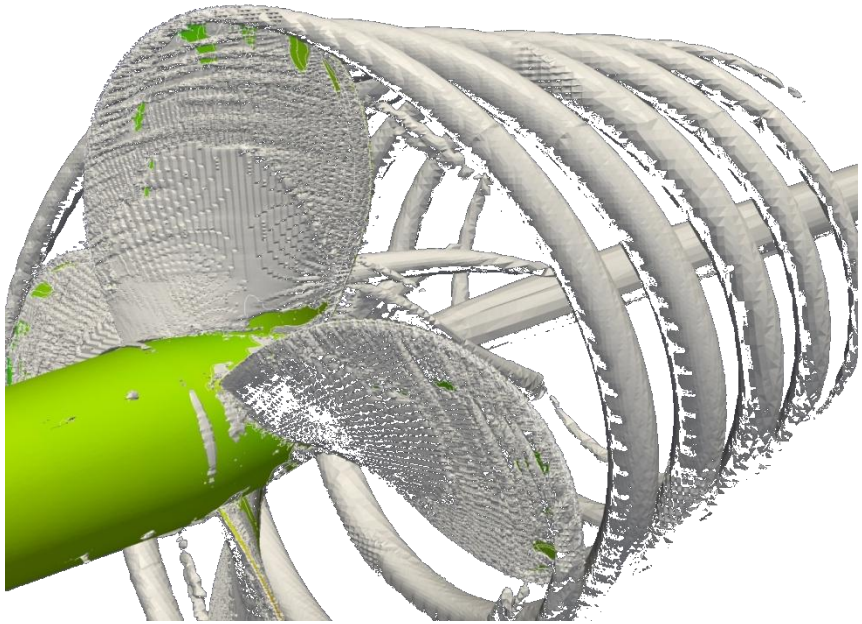
- PHOENICS
- FLOW 3D
- FLUENT
- STAR CD
- TascFlow
- ….and more

CFD codes in use in Cetena

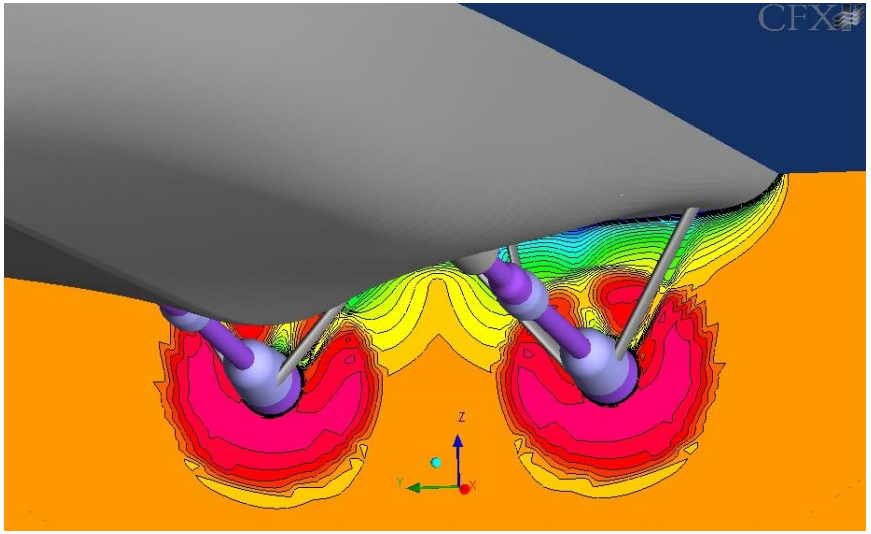
- **Home made**
  - PROPACE
  - PFP
  - WARP
- **Commercial**
  - Ansys CFX
  - Fluent
  - Star CCM+
  - Ansys ICEM

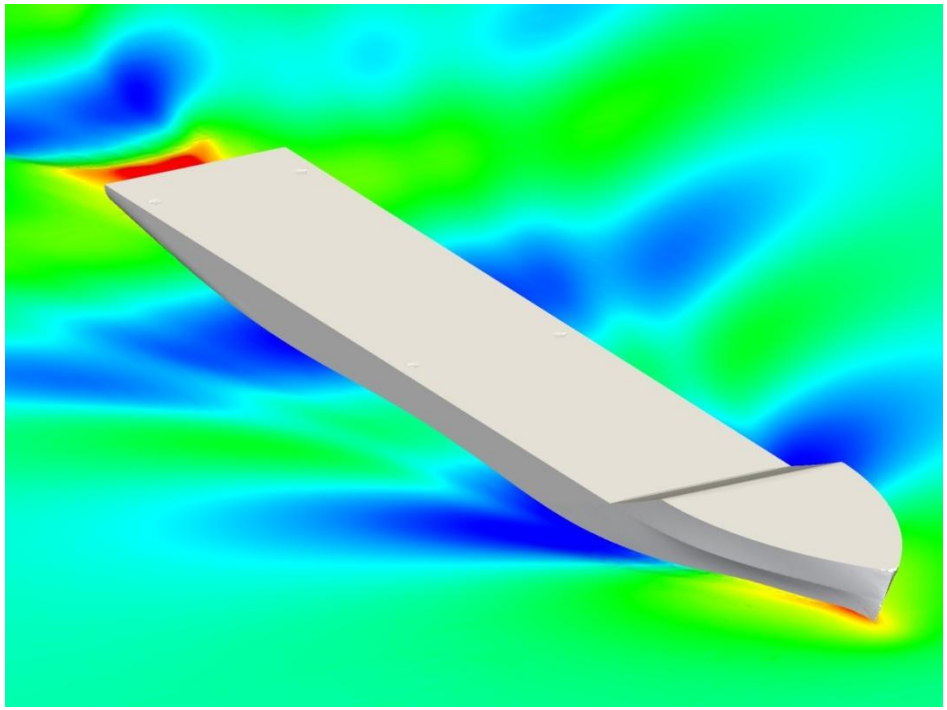
OpenFOAM

CFD application for design support



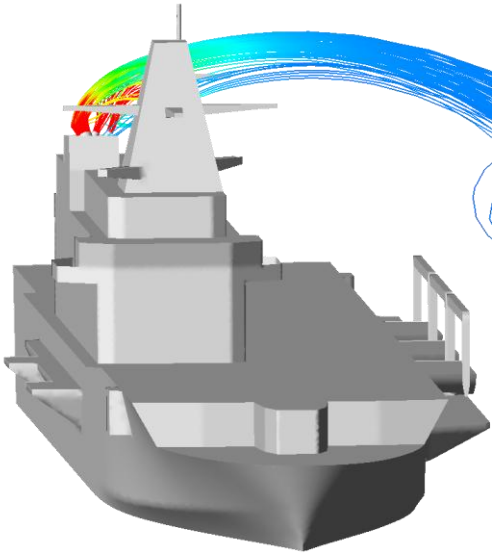
- ✓Propeller analysis
- ✓Hull form analysis
- ✓Hull–propeller interaction

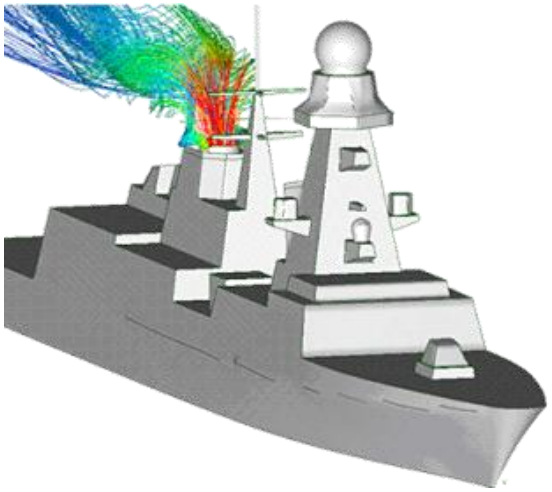


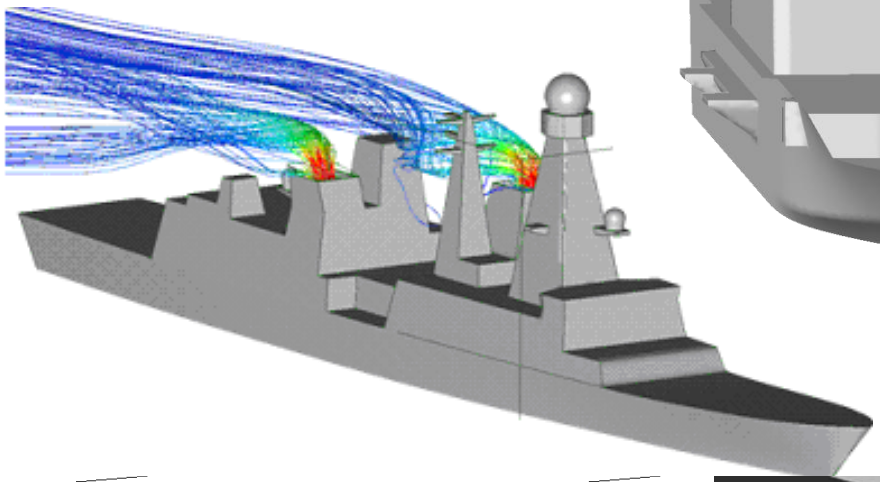


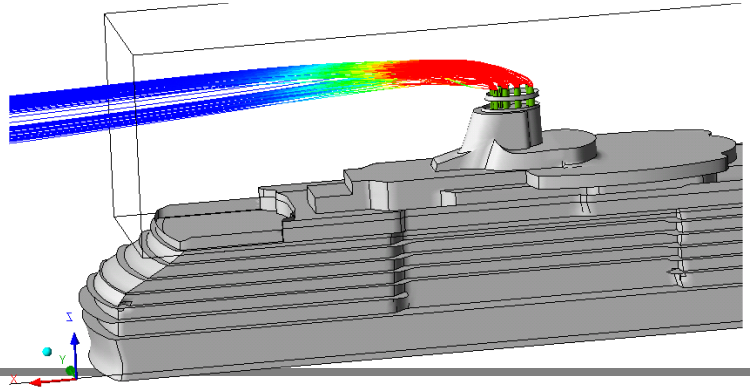
CFD application for design support
Ship Aerodynamics

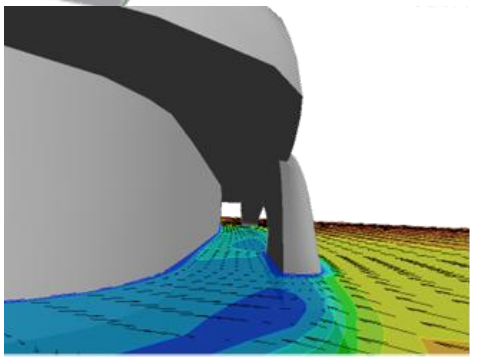
Exhaust gases interaction with electronic equipment
Particle tracking



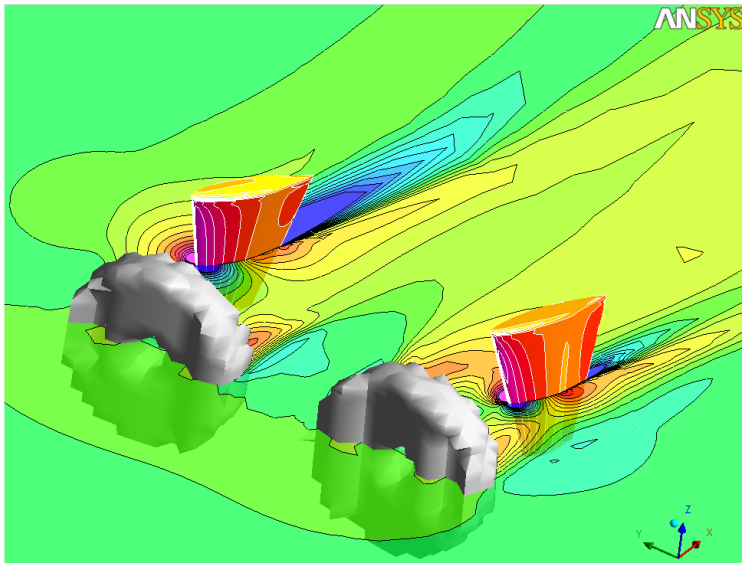






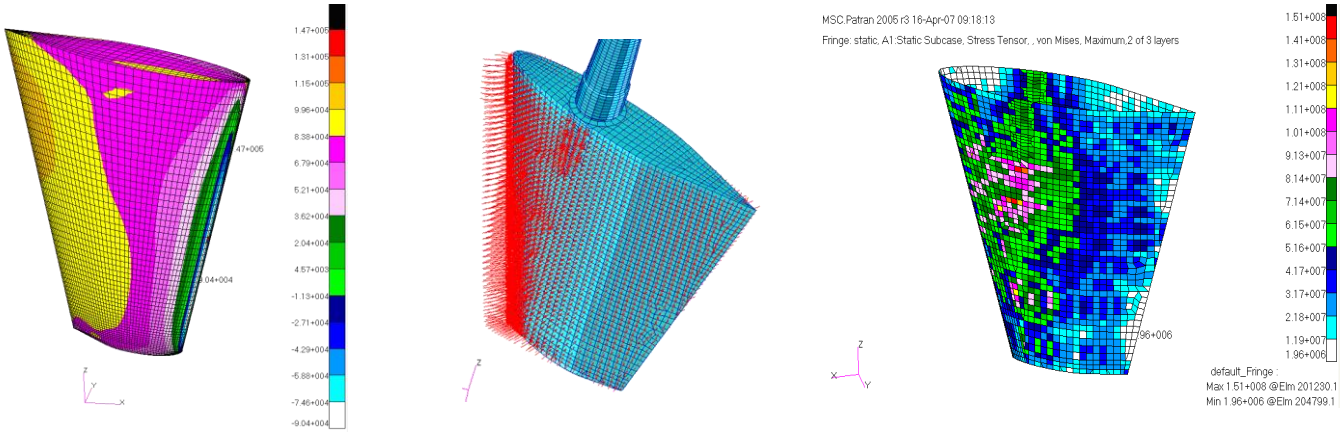


CFD application for design support
CFD / FEM coupling



Computation of **forces acting on rudder** and **stress distribution**.

Propeller effect is introduced through analytical distribution in the computational domain at the propeller location.



Stress distribution

CFD application for design support

Experimental fluid dynamics

Pros:

It represent the real physical phenomena

Easy to understand as we see the phenomenon happening

Cons:

Costly experimental setup

Fixed setup. If we need different measure we need new setup.

Various measurements require a wide range of apparatus

Limited numbers of points and time instants

Computational fluid dynamics

Pros:

No requirement of physical setup

Not much cost involved

Can model most physical phenomena in a single setup

Can gather lots of data by just solving the simulation once

Cons:

Not easy to understand, complex physical models

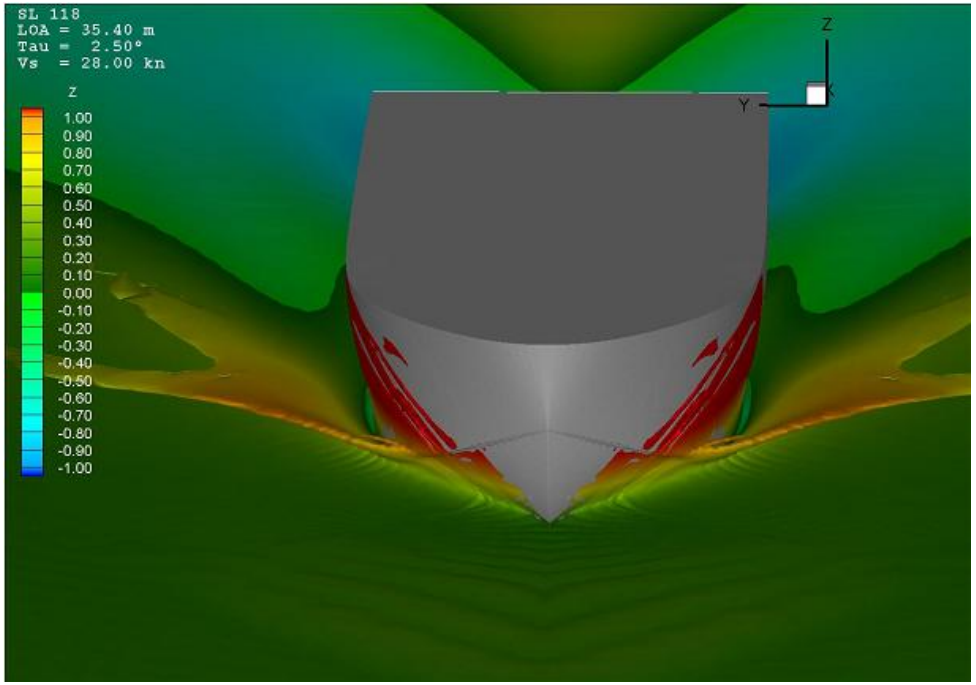
Simulations are limited by availability and quality of mathematical model

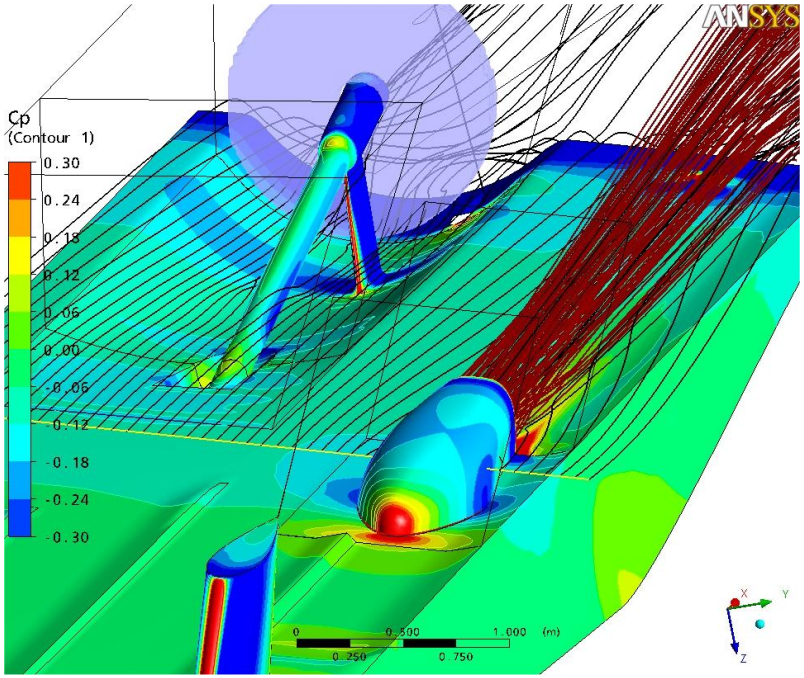
Most complex simulations need powerful computers

CFD application for design

Multiphase and multicomponent simualtion

- ✓ Hydrodynamic analysis
- ✓ Exhaust discharge optimization
- ✓ Propeller exhaust gas interaction

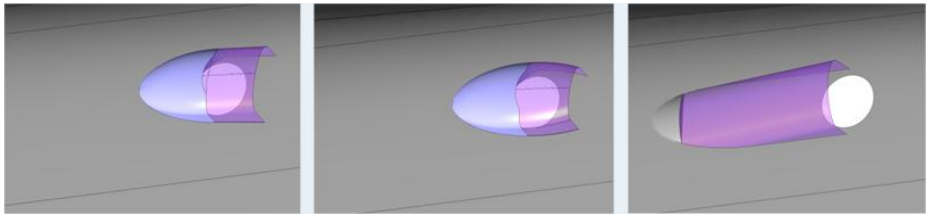


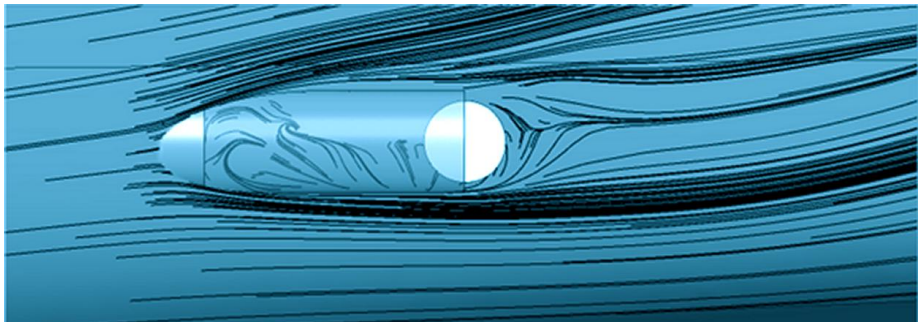


CFD application for design support

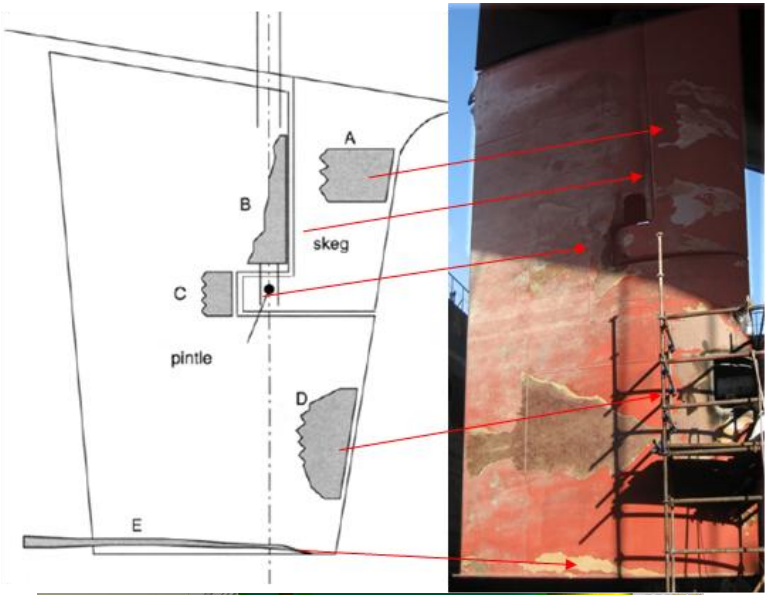
Engine exhausts outlet cover optimisation

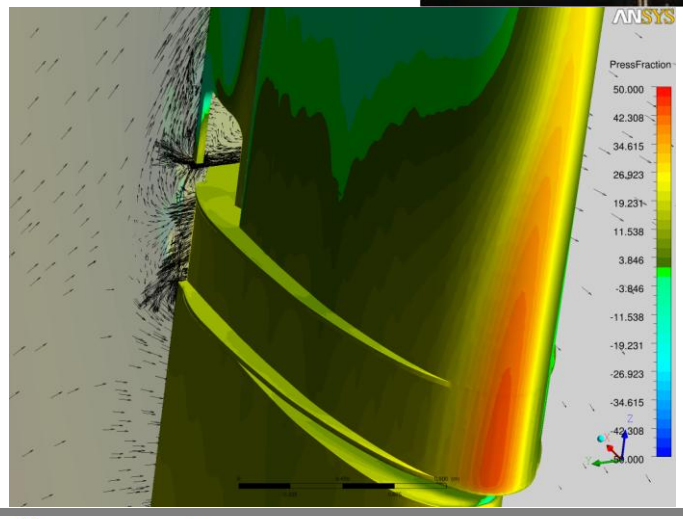
- ✓ Wave pattern
- ✓ Flow visualization at the exhausts discharge,
- ✓ Engine exhausts outlet cover allignement
- ✓ Cover optimization in order to reduce back-pressure at the engine



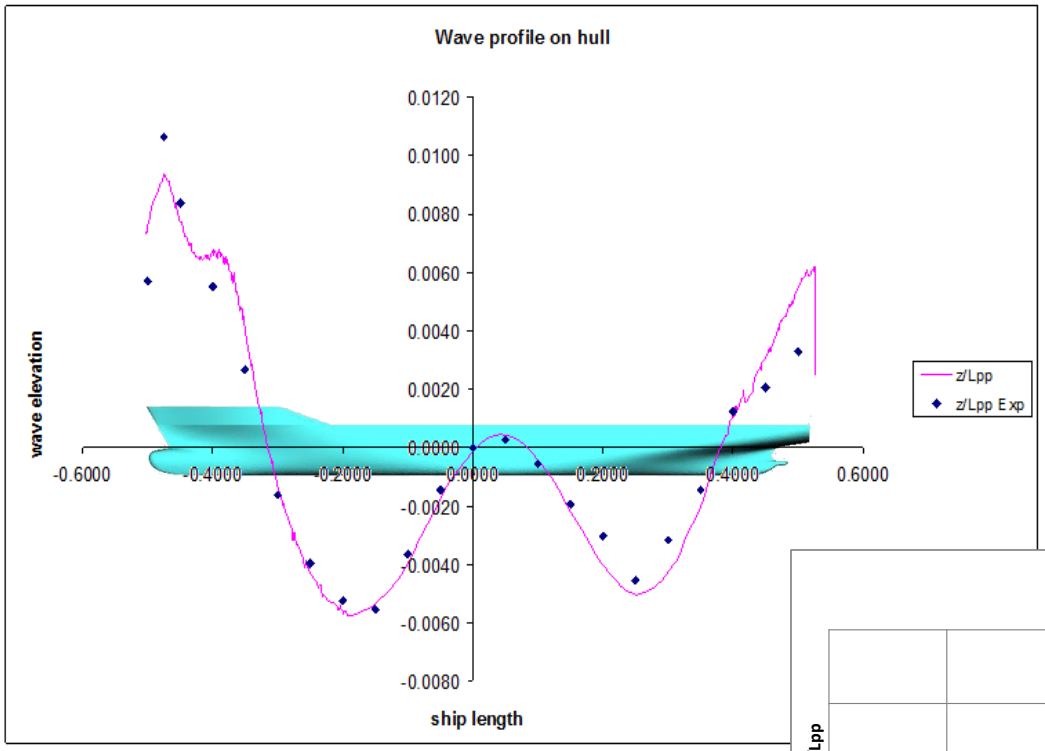


CFD application for refitting – Rudder Erosion CFD experimental Tests



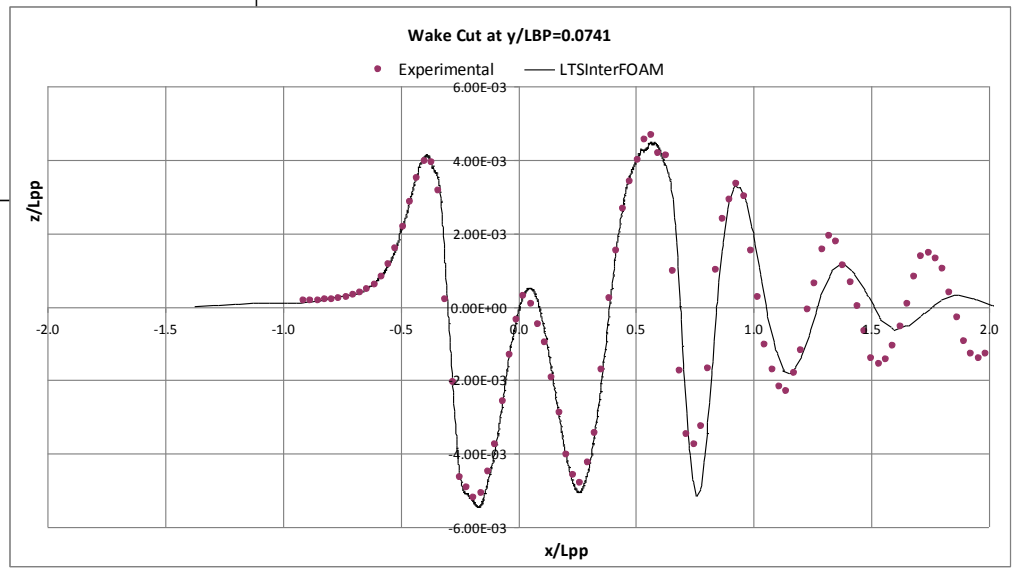


OpenFoam - Wave pattern / hull resistance

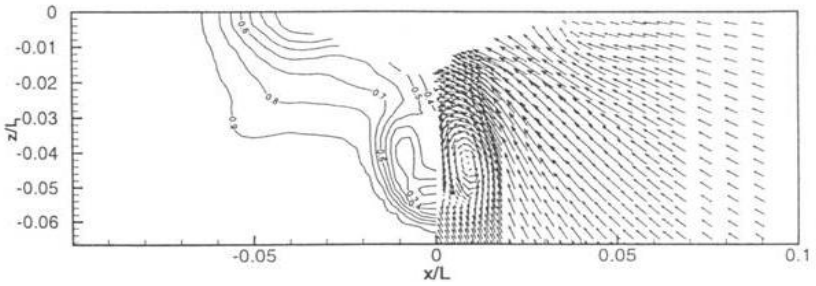


KCS results

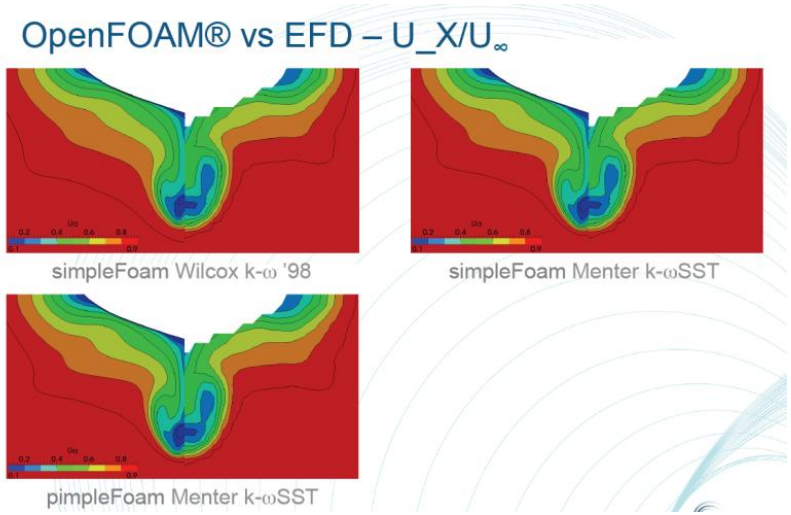
Solver	Cells	CT	Δ%
EXP		0.003519	
interFOAM	3361811	0.003465	-1.55%
interFOAM	2548686	0.003405	-3.25%
interFOAM	2699441	0.003404	-3.26%
LTSInterFOAM	1108484	0.003446	-2.08%



OpenShip results

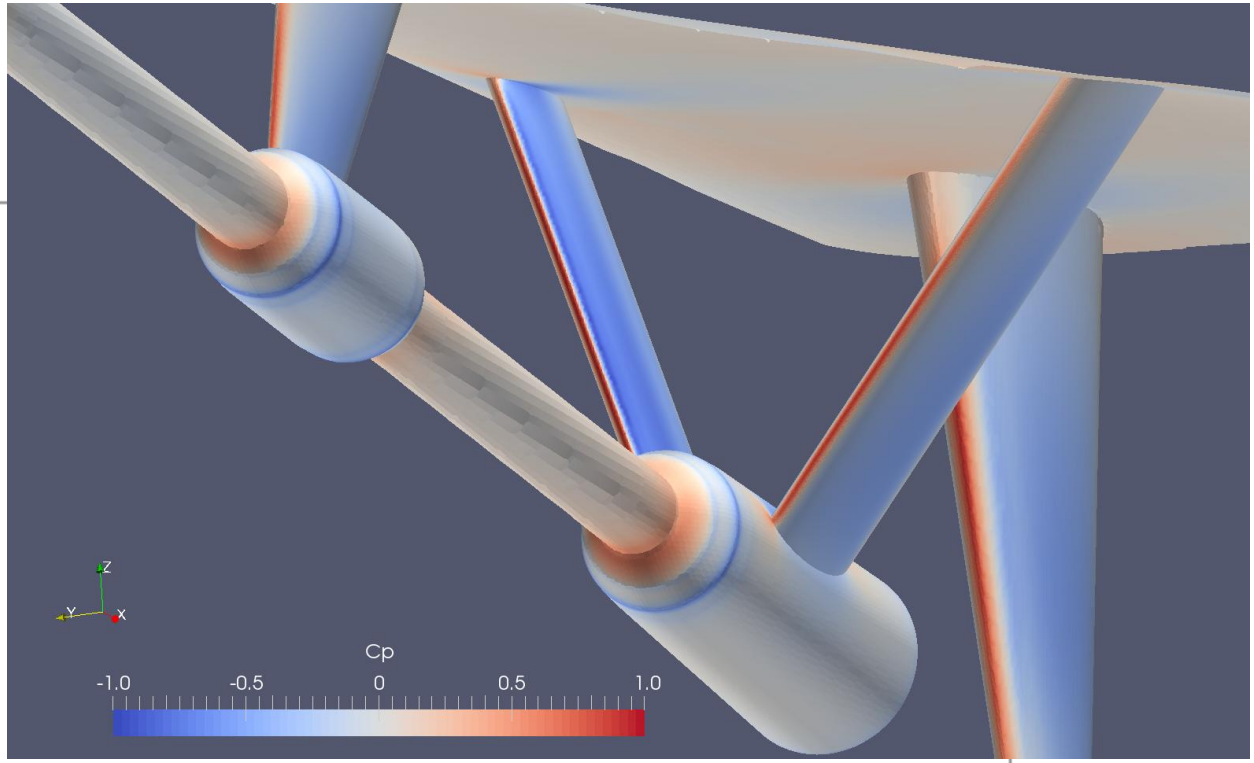


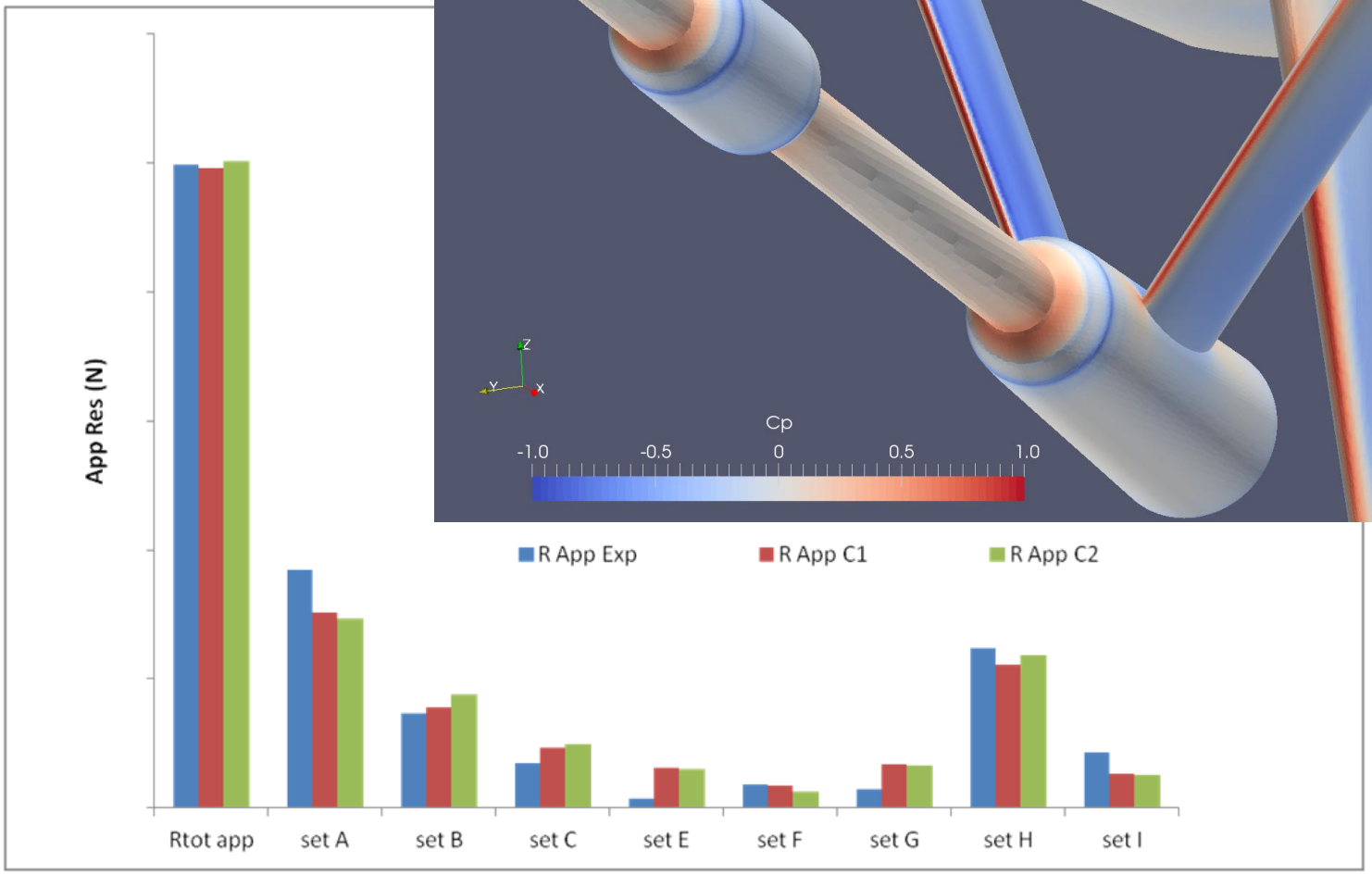
AnsysCFX



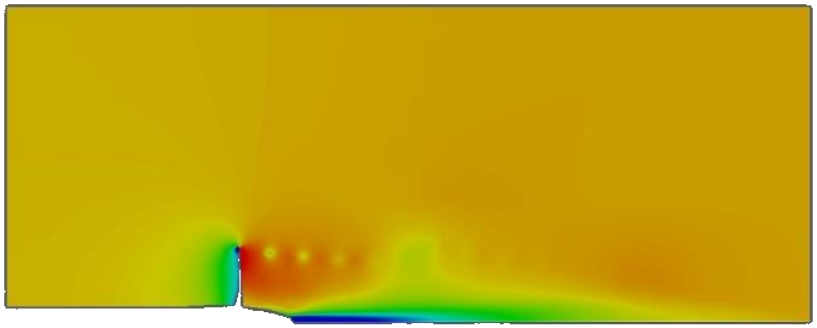
OpenFOAM

Hull Appendages Resistance

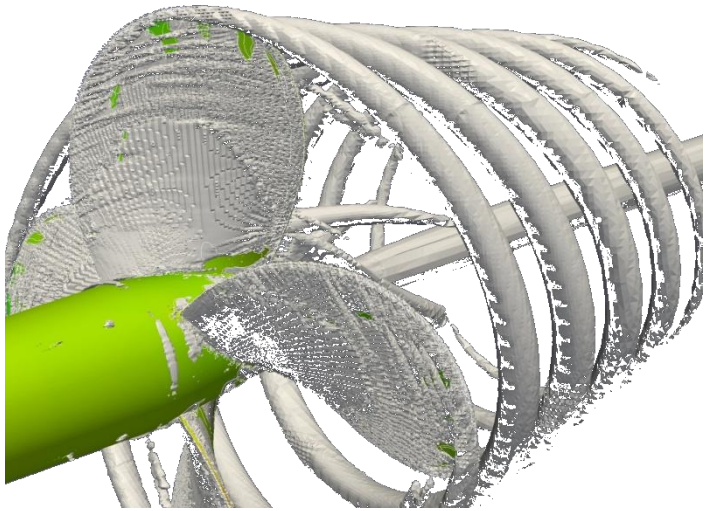


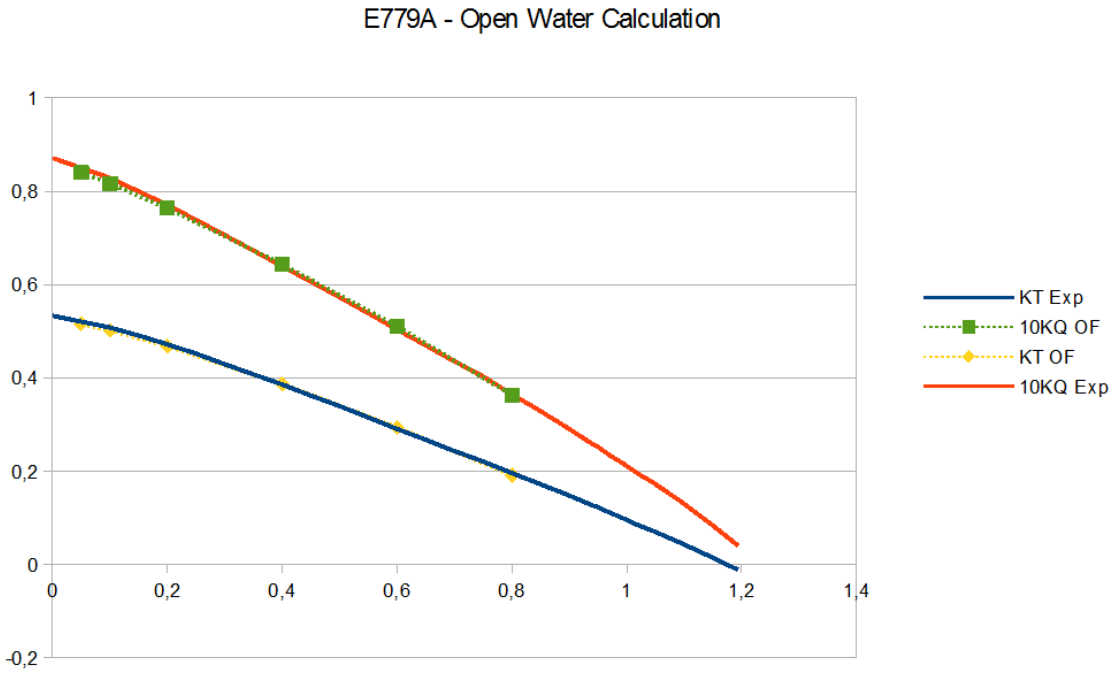


Open Water Propeller

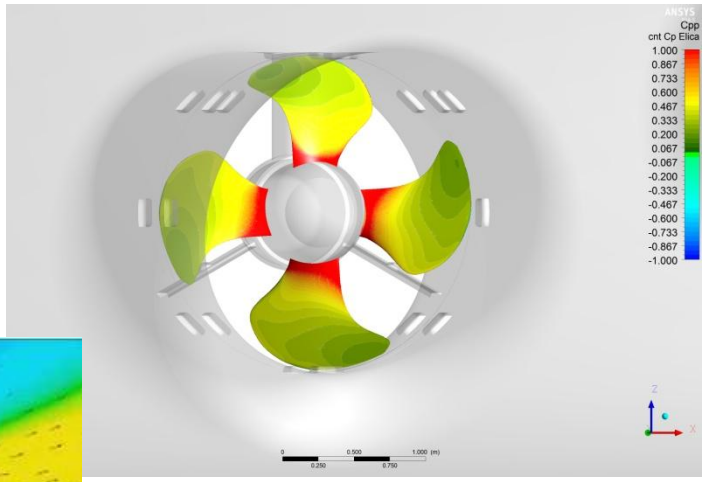


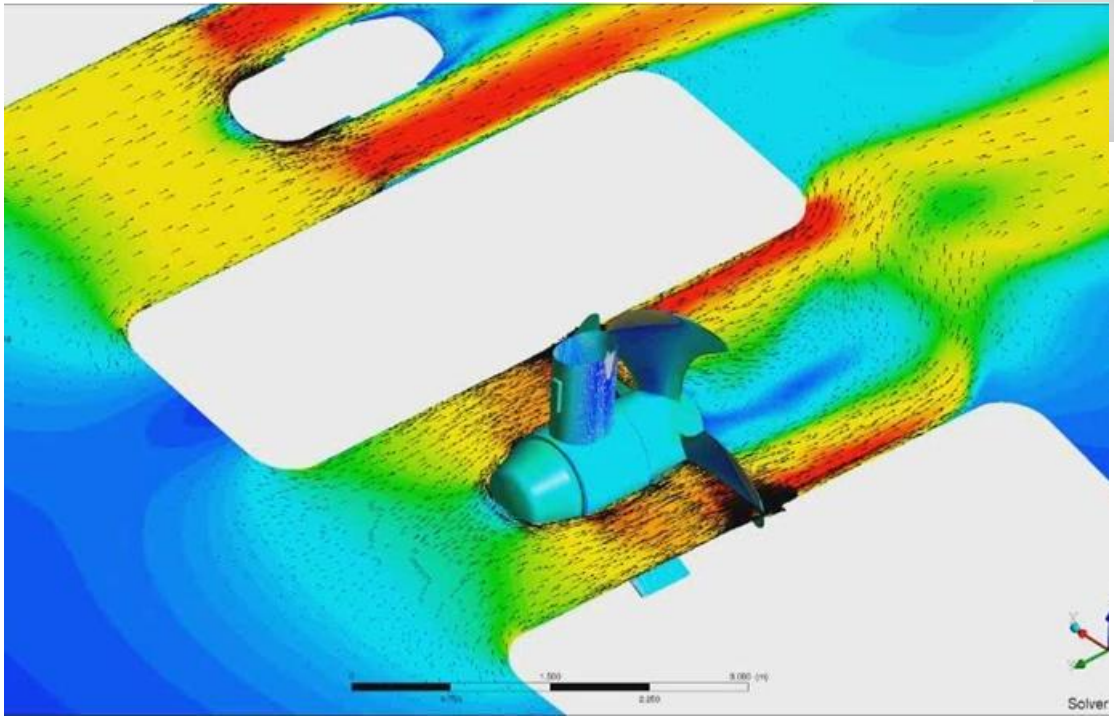
Propeller E799A open water results



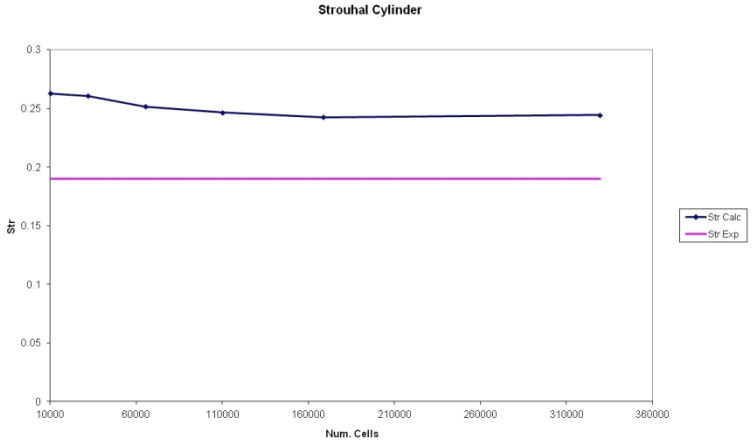


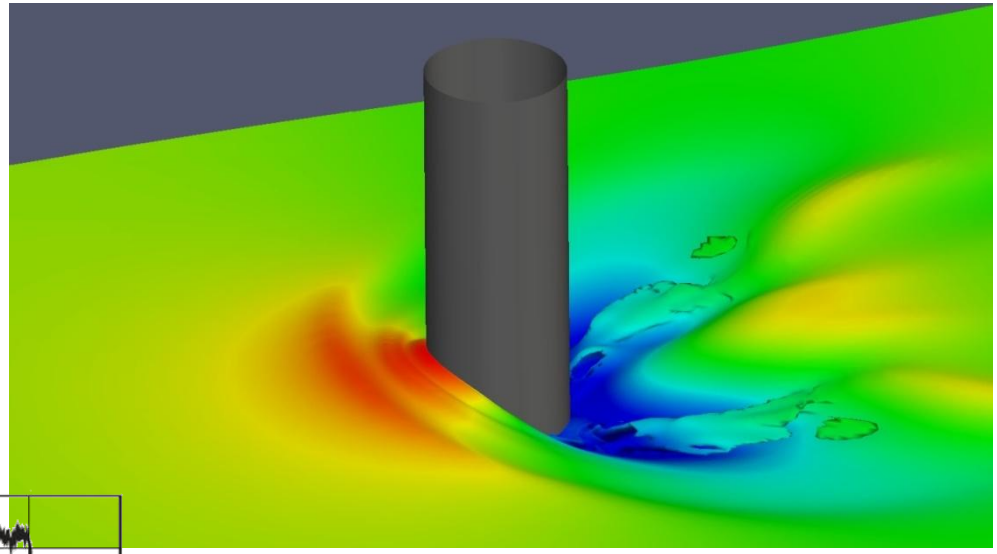
CFD advanced applications
Unsteady calculation for hull / propeller interaction

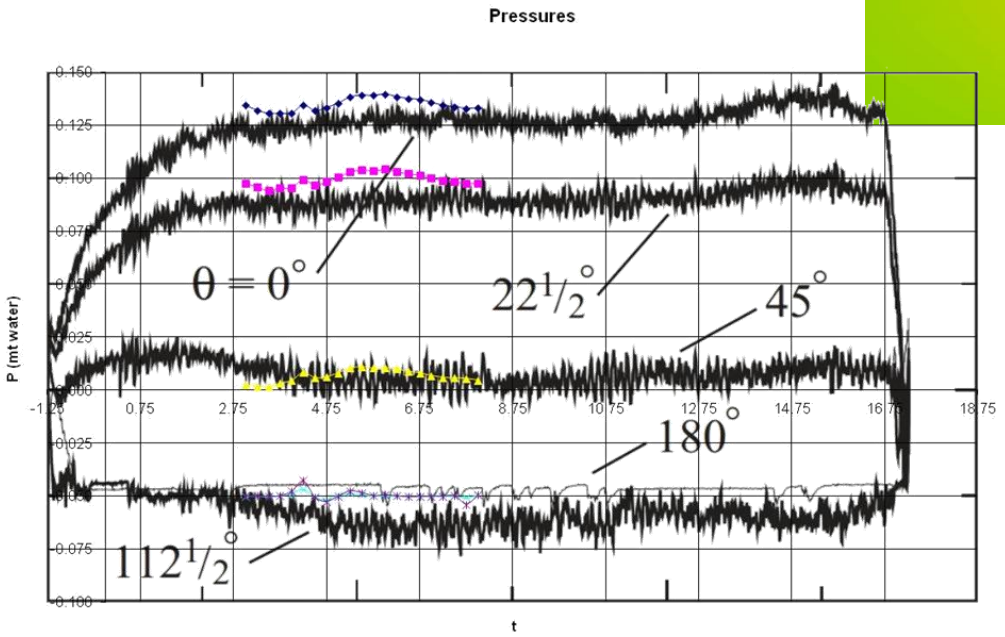


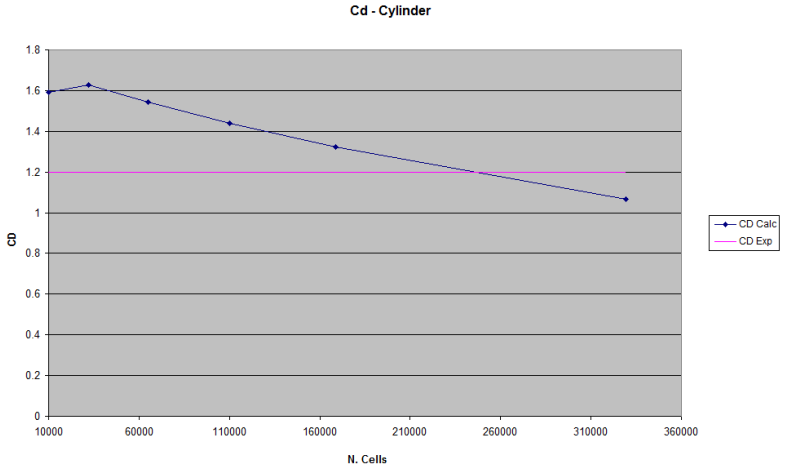


Flow past vertical cylinder

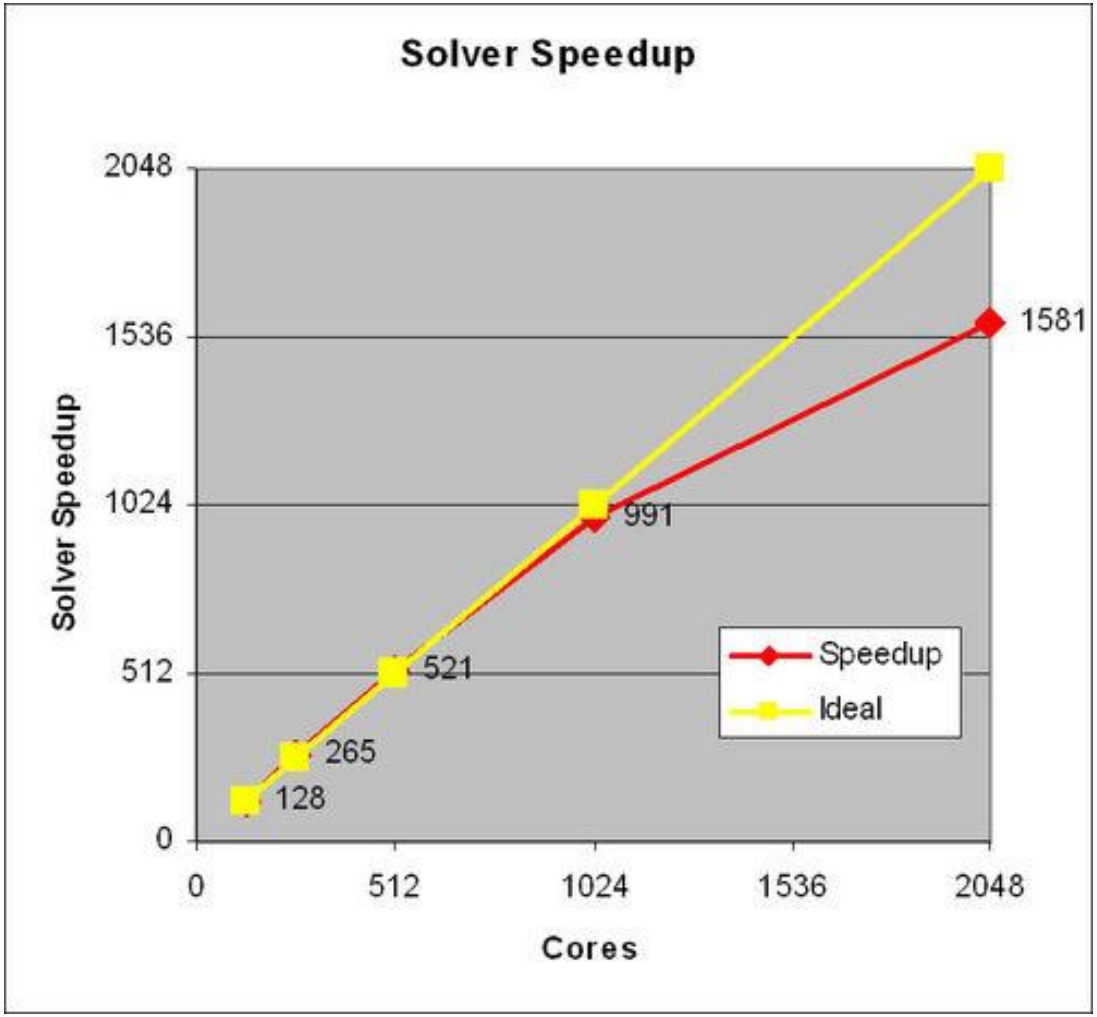




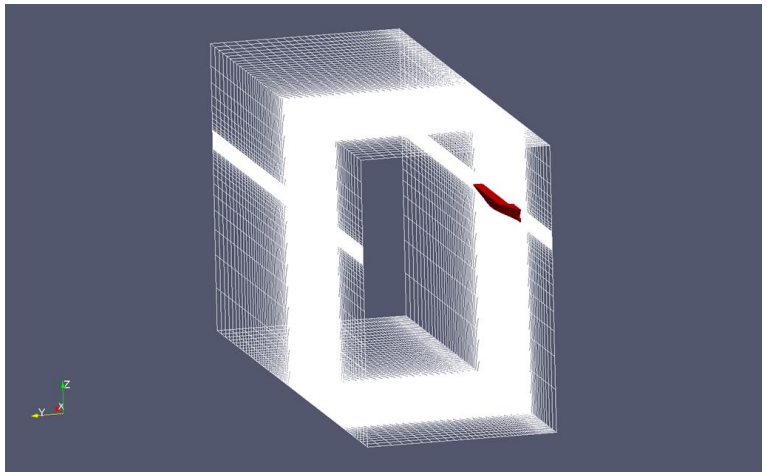


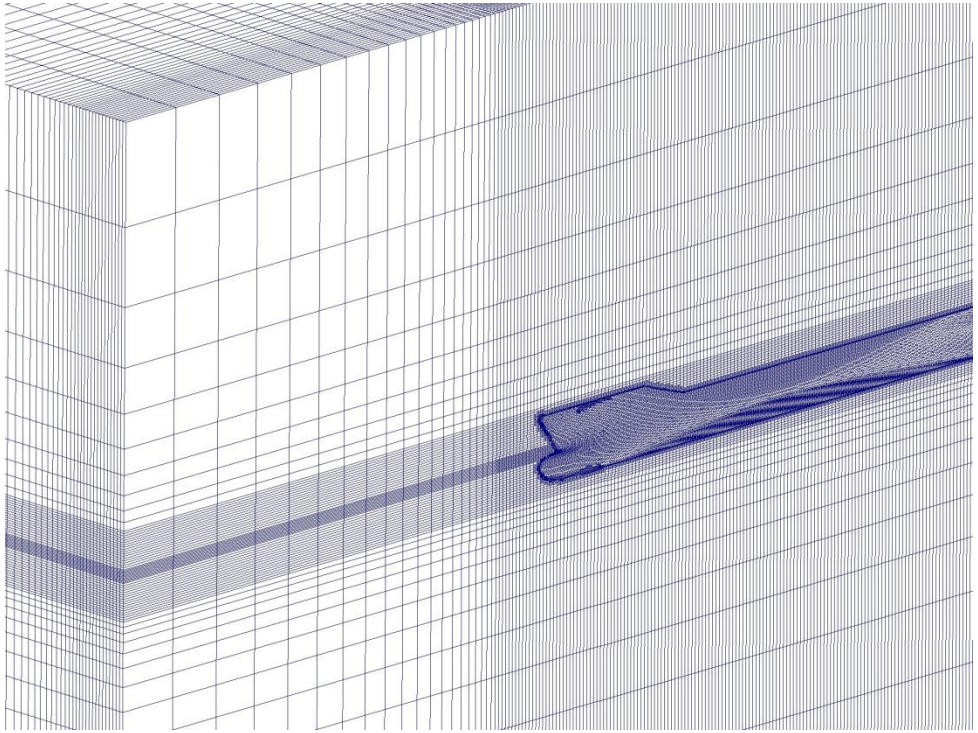


OpenFOAM Scaling Test

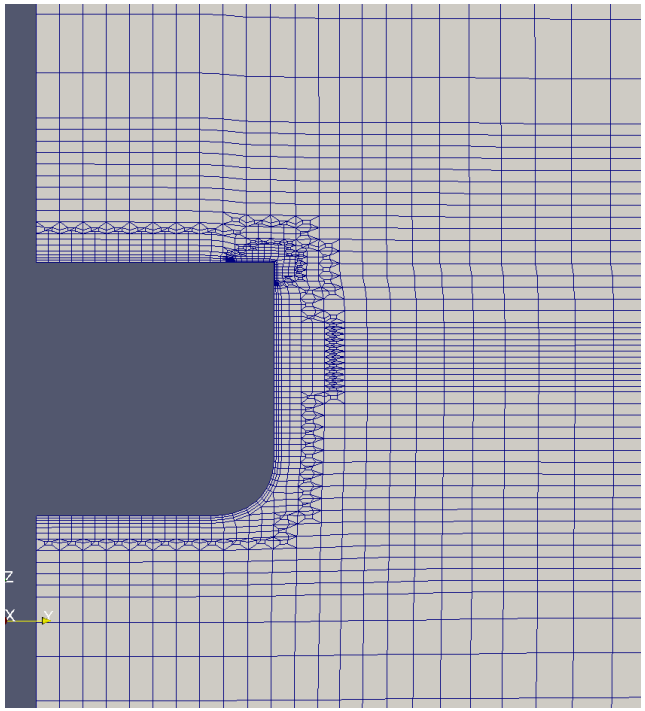


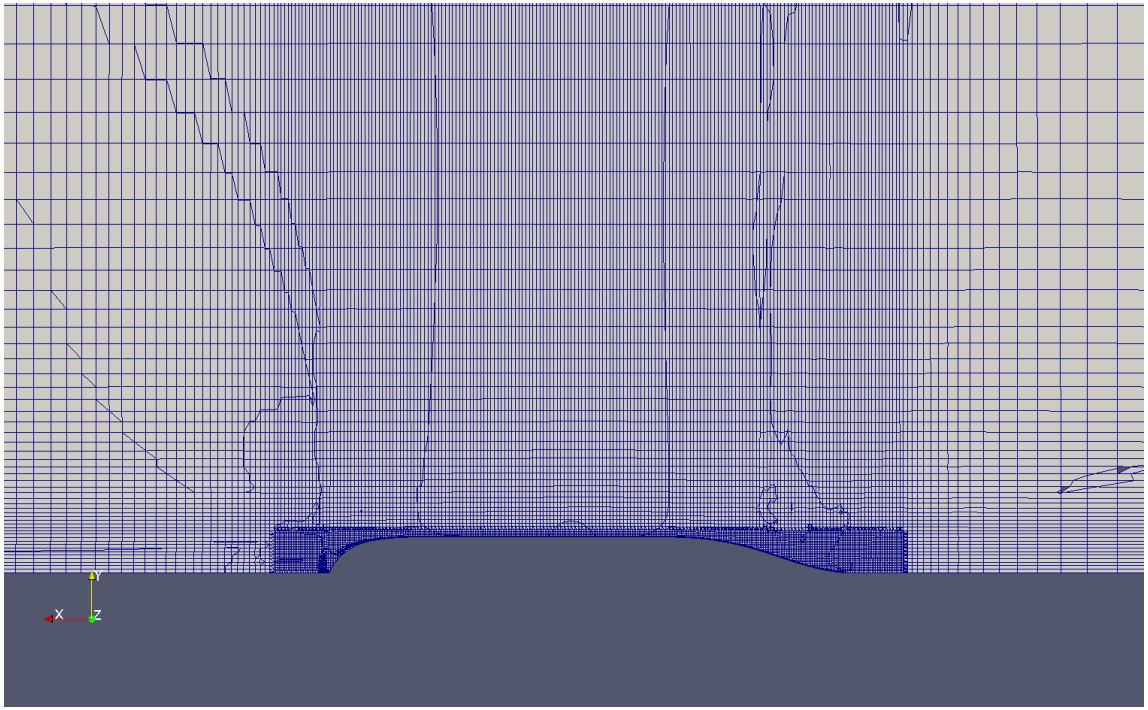
CFD boundery conditions KCS Tanker



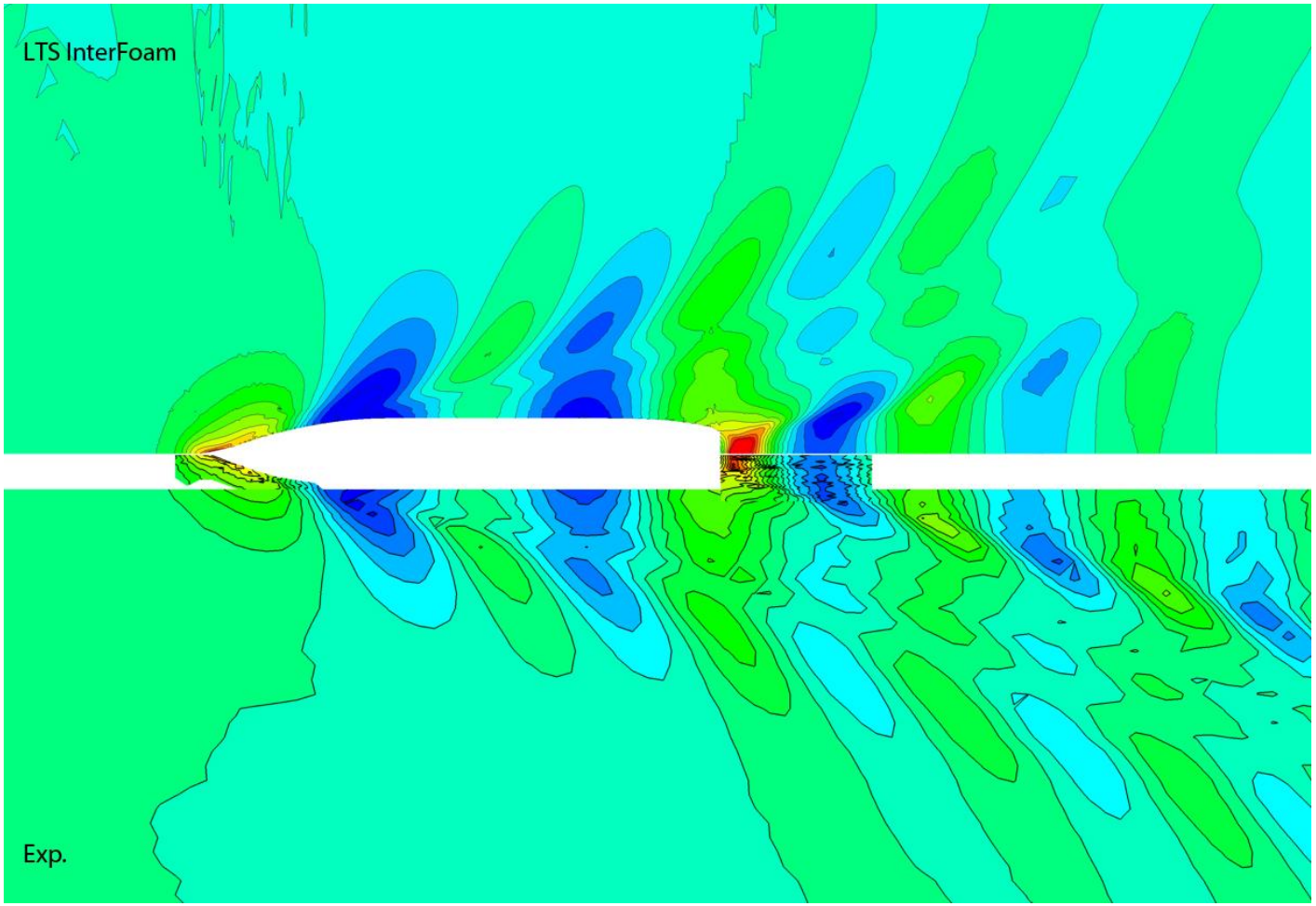


CFD grid analysis KCS Tanker





CFD KCS results



KCS total drag

Solver	Cells	CT	Δ%
EXP		0.003519	
interFOAM	3361811	0.003465	-1.55%
interFOAM	2548686	0.003405	-3.25%
interFOAM	2699441	0.003404	-3.26%
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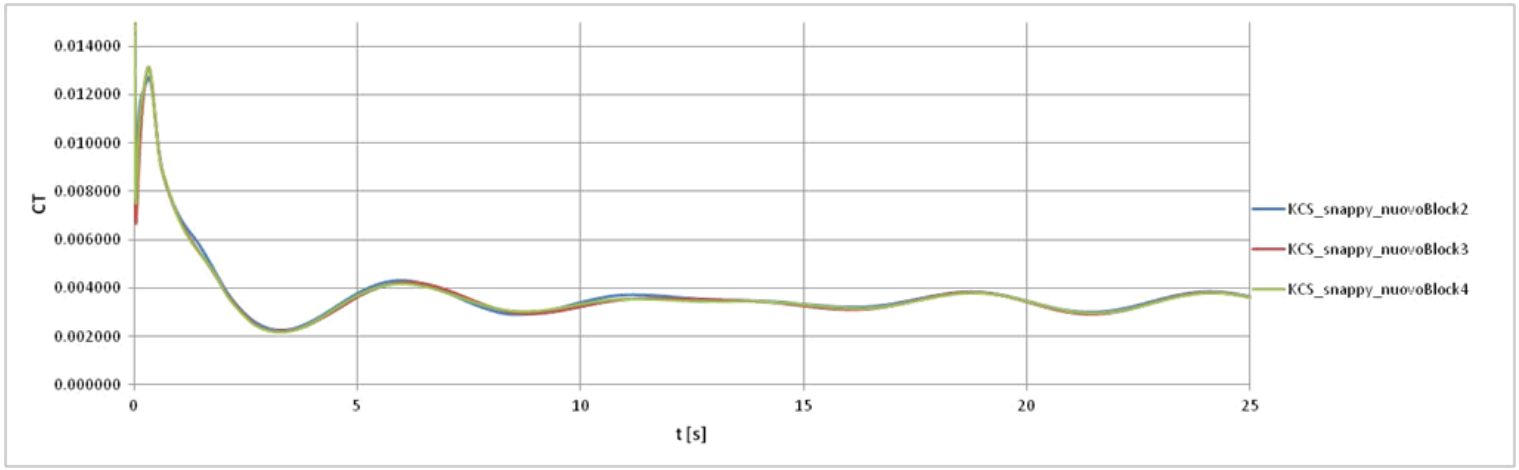
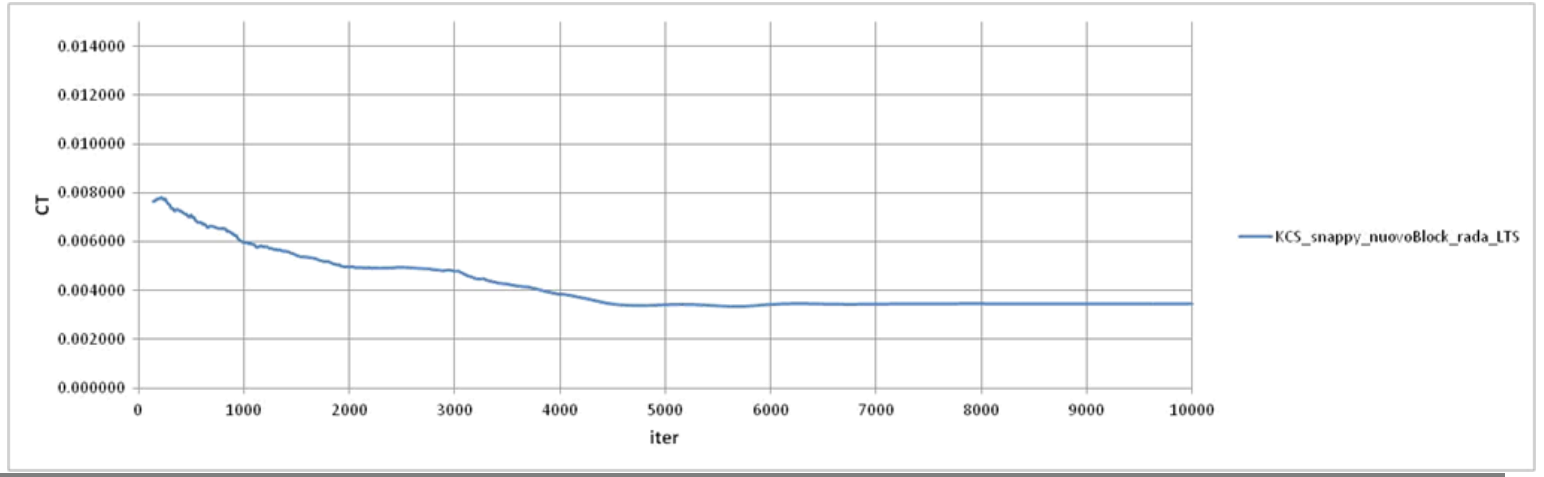




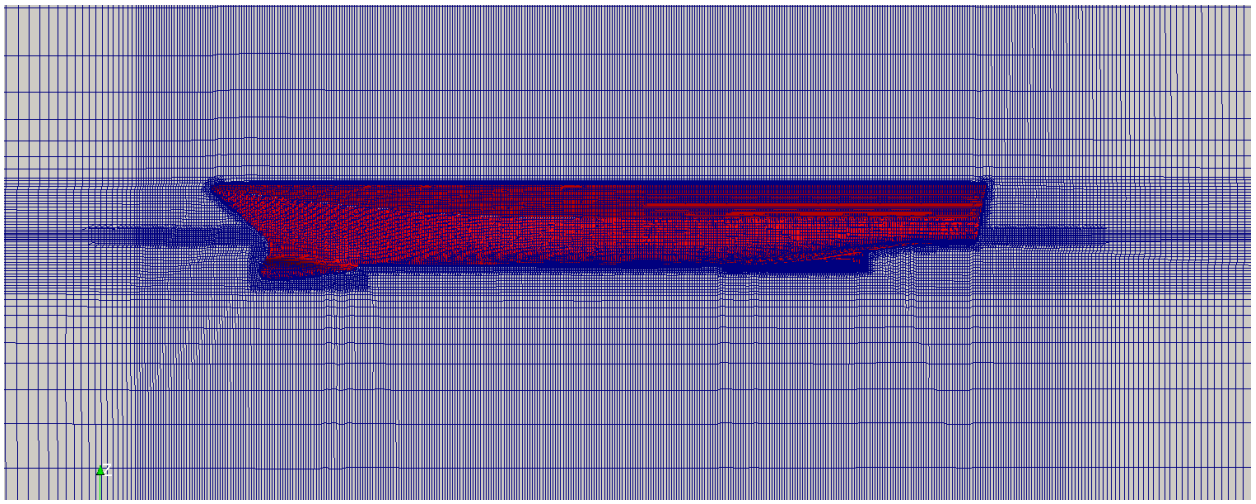
Combat vessel calculation

Fixed T&S:

2.25 M cells

Software:

OpenFOAM 2.2

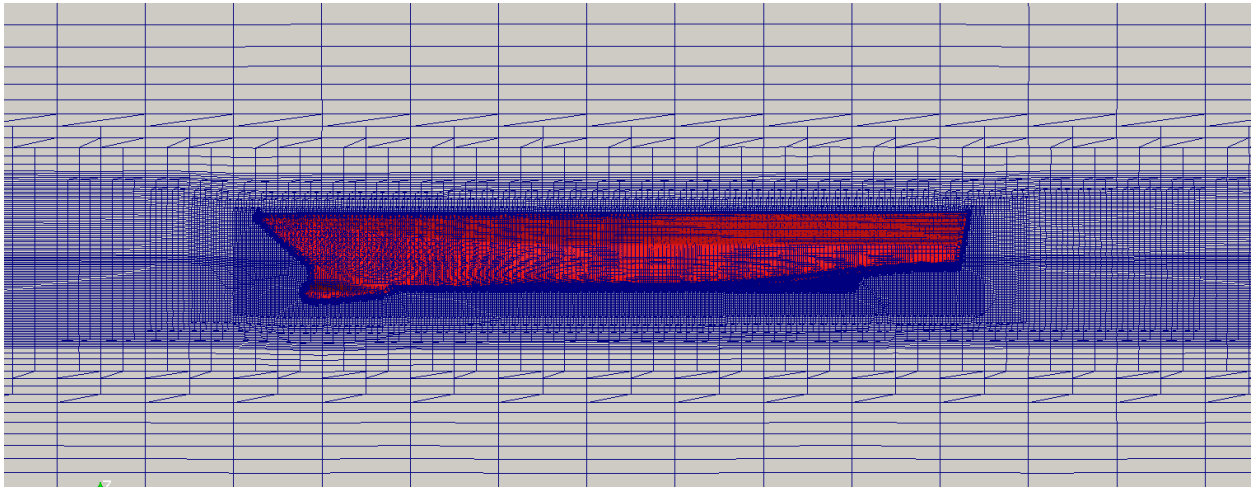


Free T&S:

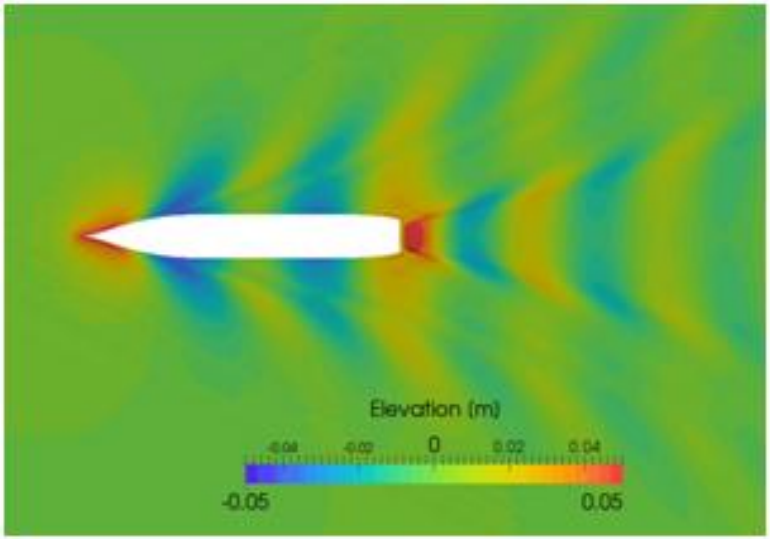
2.8 M cells

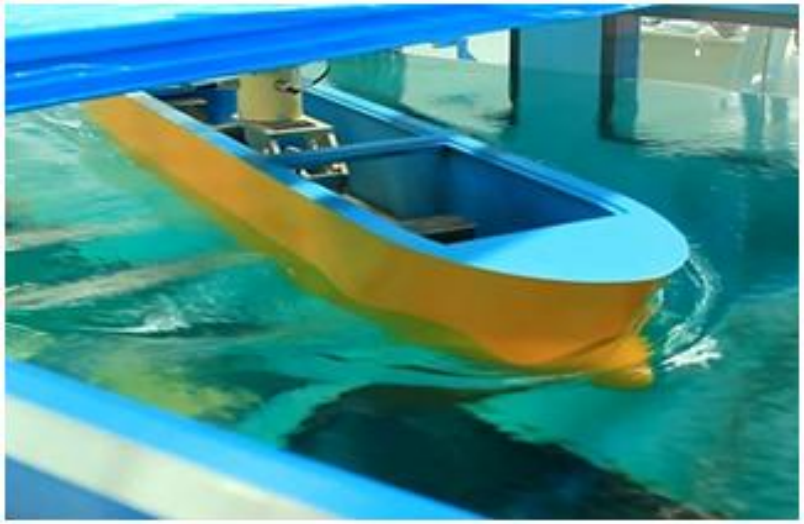
Software:

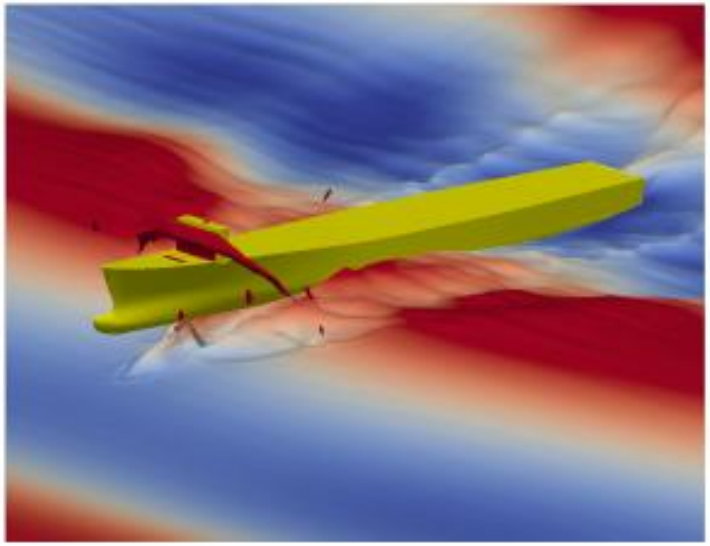
OpenFOAM 2.3



CFD next steps







Thank you for your attention