



**Università
di Genova**

DITEN DIPARTIMENTO
DI INGEGNERIA NAVALE, ELETTRICA,
ELETTRONICA E DELLE TELECOMUNICAZIONI

Underwater Vehicles: the Naval Architecture experiences

Speaker: **Ph.D. Diego Villa**

Past and Present projects

UNIGE-DITEN projects on Underwater Vehicles (UV):

- **ASAMS** - *Aspetti specialistici e approccio metodologico per la progettazione di sottomarini di ultima generazione*

The aim of this projects was to develop the knowledge for design new national submarine units.

- **SUBMAN** – Development of a submarine hydrodynamic simulator
- **Hydrone-D Defence applications** - *Drone sottomarino modulare e multimissione, dual use*

The aim was to characterize from hydrodynamic point of view a new AUV unit.

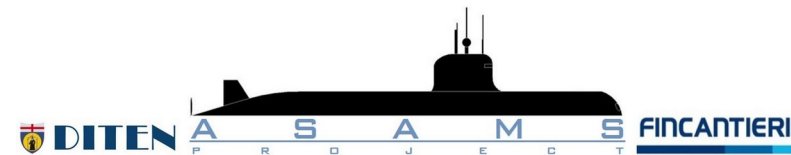


Overview of the **ASAMS** project

This project was devoted to increasing the knowledge of National Shipyards (Fincantieri) on the design of Submarine units supported by the Italian Navy (Defense Minister).

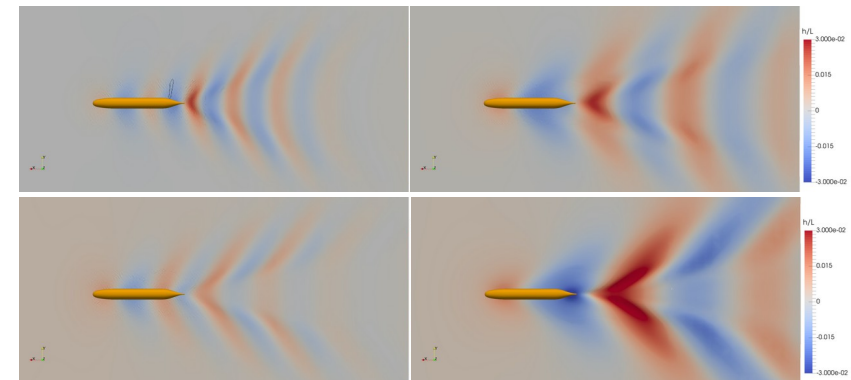
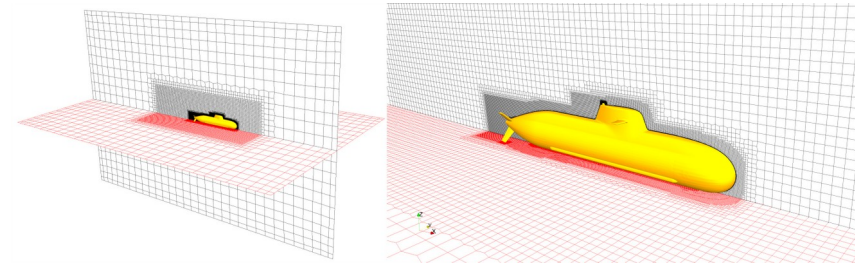
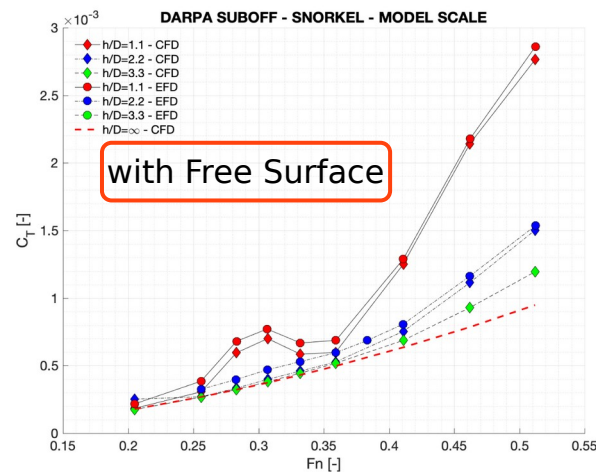
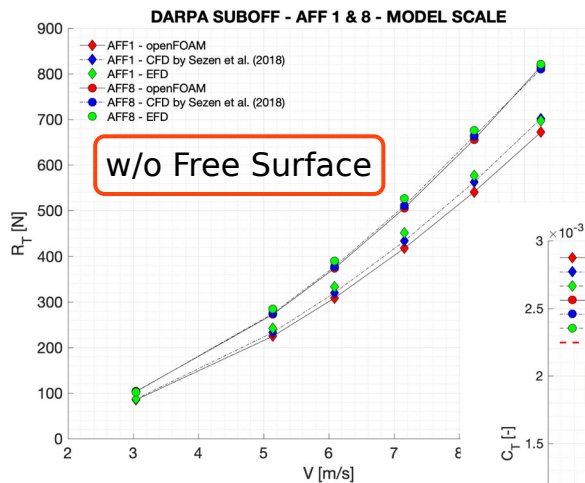
The project focus was subdivided into all the typical marine branches within the classical design spiral:

- Definition of the ship resistance and the propulsion power
- Definition of the maneuvering capability
- Definition of the optimal structural design
- Definition of the noise impact of the unit
- Definition of the best propulsion plan



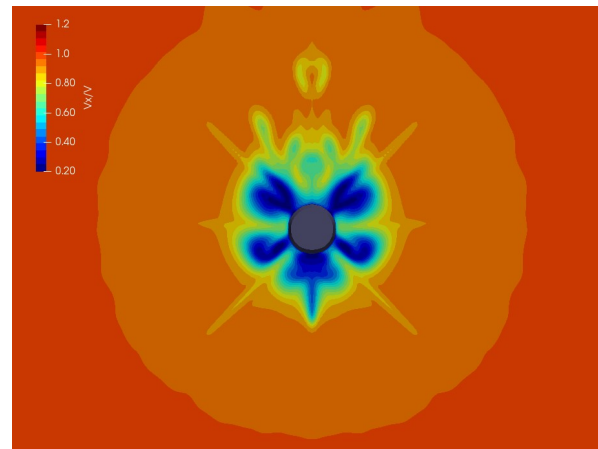
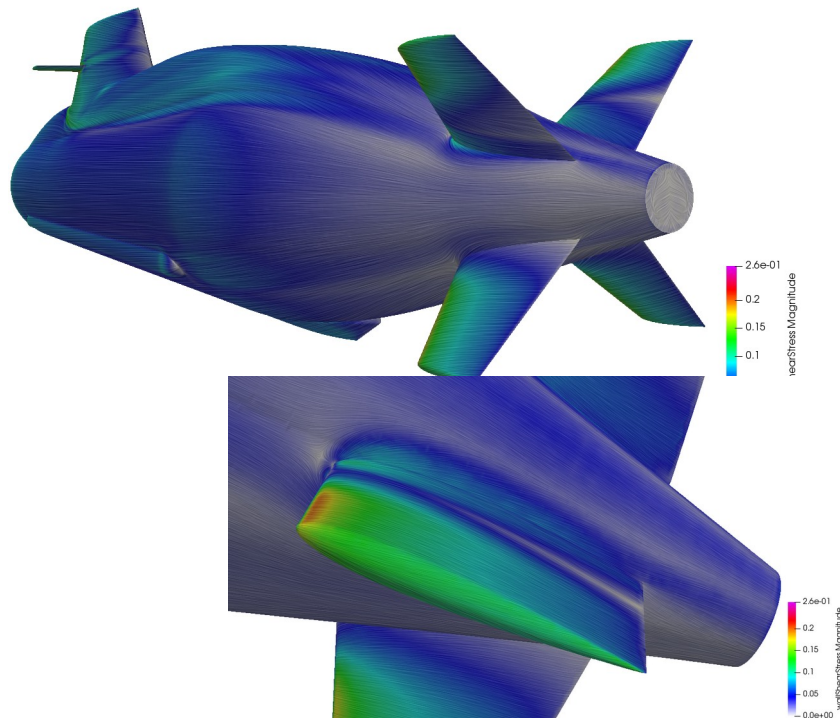
Overview of the ASAMS project

From a hydrodynamic point of view, the goal was to investigate the application of modern Computational Fluid Dynamic (CFD) codes for the characterization of the unit, in terms of **resistance**:

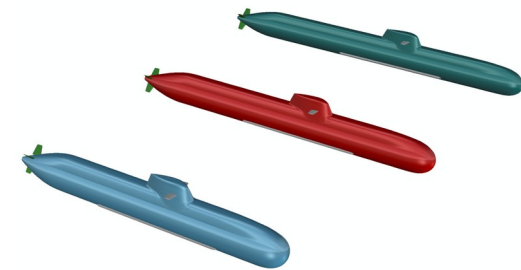


Overview of the ASAMS project

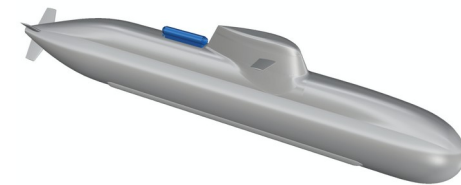
From a hydrodynamic point of view, the goal was to investigate the application of modern Computational Fluid Dynamic (CFD) codes for the characterization of the unit, in terms of **flow-field** and impact of **geometries**:



Global shape



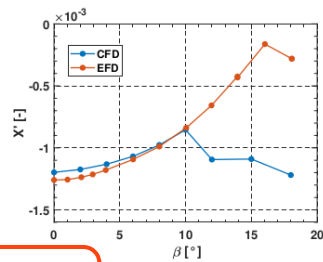
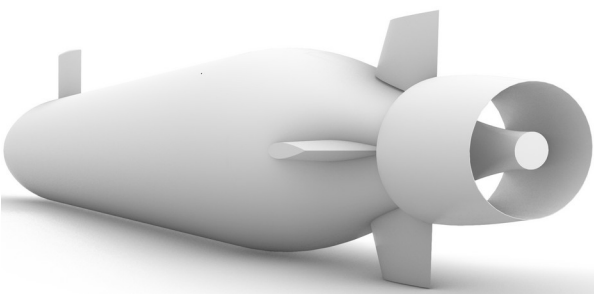
Local details



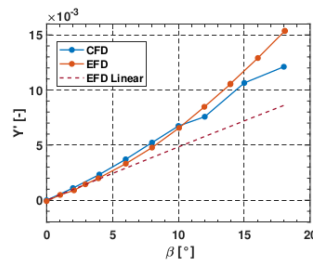
Overview of the ASAMS project

From a hydrodynamic point of view, the goal was to investigate the application of modern Computational Fluid Dynamic (CFD) codes for the characterization of the unit, in terms of **maneuvering**:

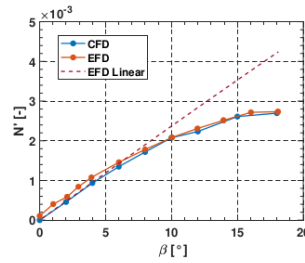
PMM
Planar Motion Mechanism



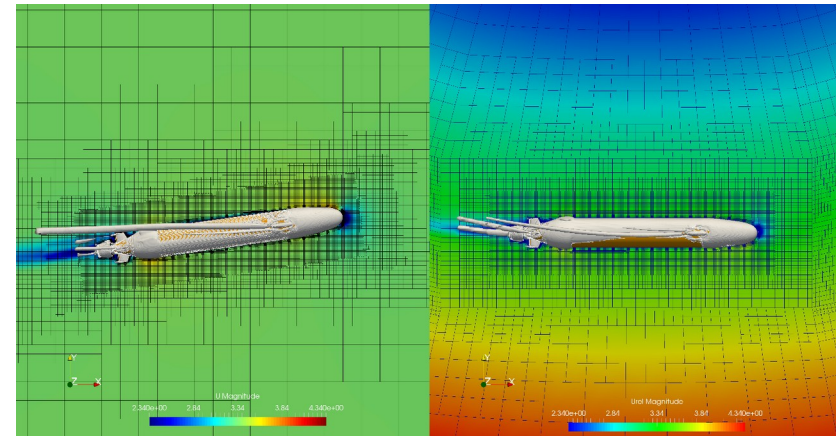
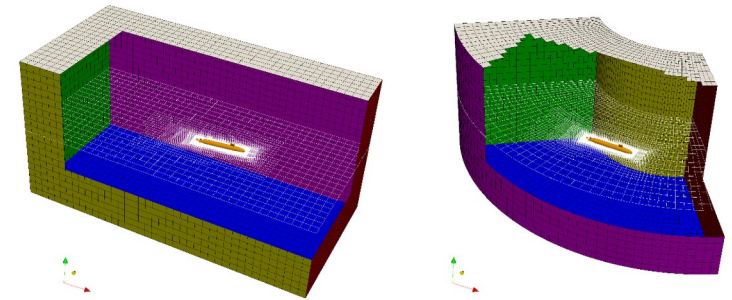
(a)



(b)



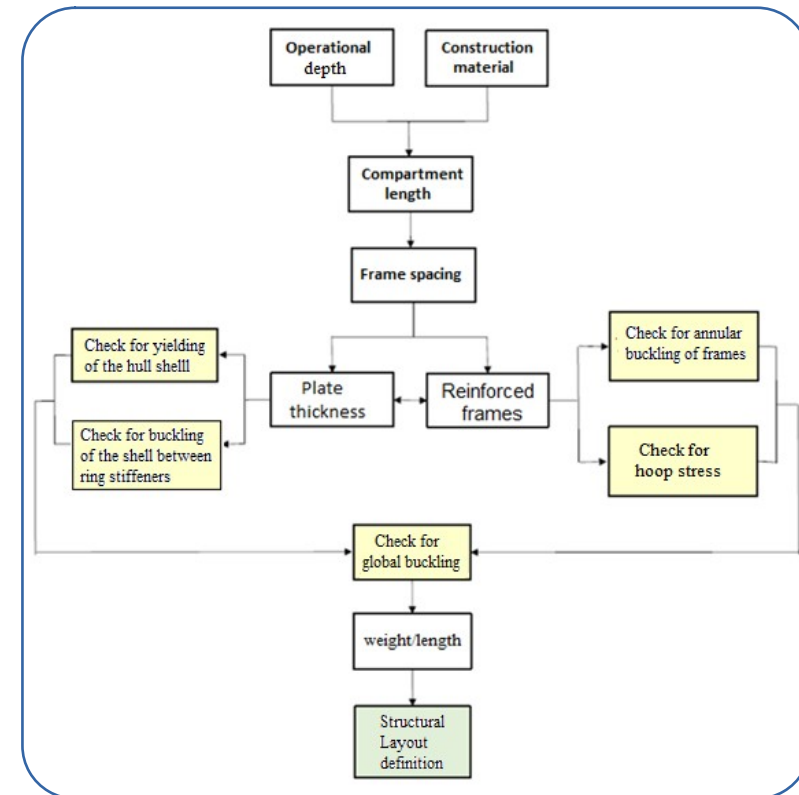
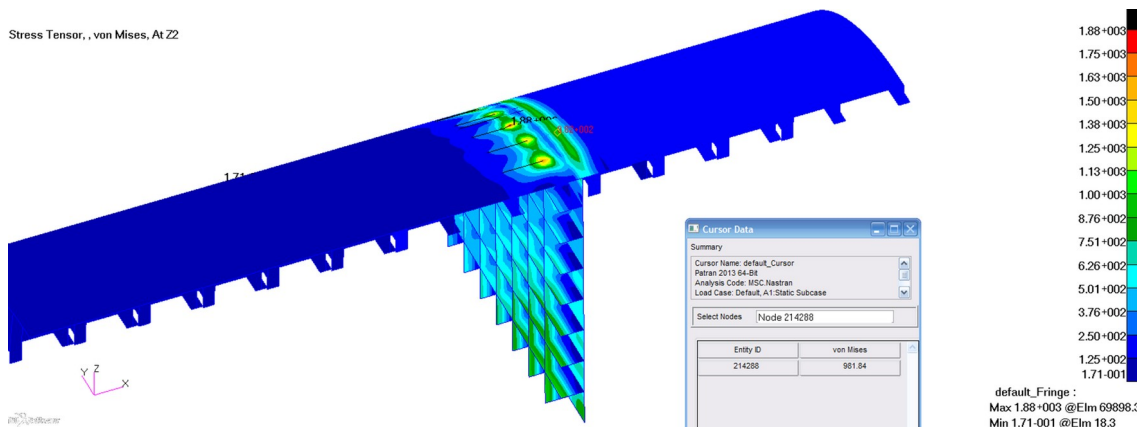
(c)



Overview of the ASAMS project

From a structural point of view, the goal was to investigate the impact of the **structures** on the design. Different sub-topics were considered, such as:

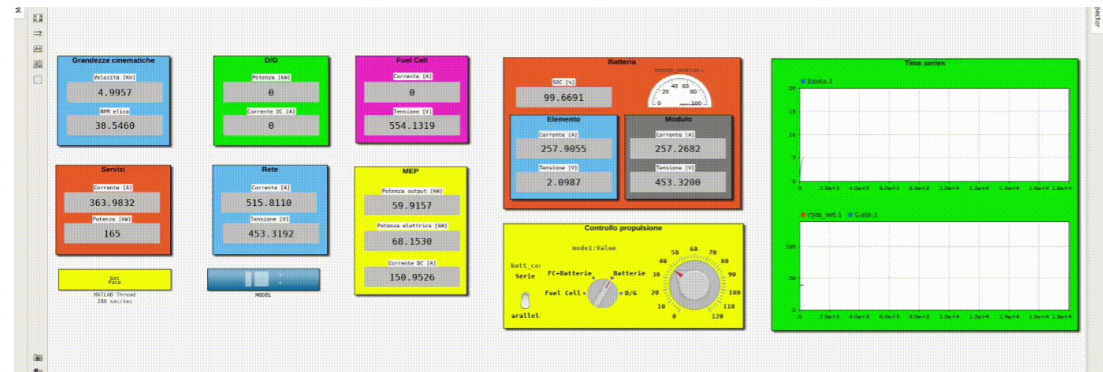
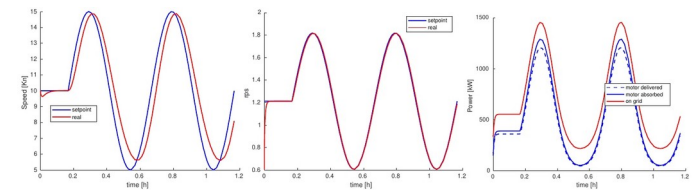
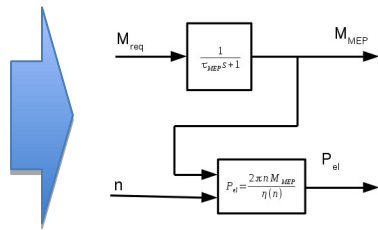
- Optimal scantling
- Detailed structural design (by FEM codes)



Overview of the ASAMS project

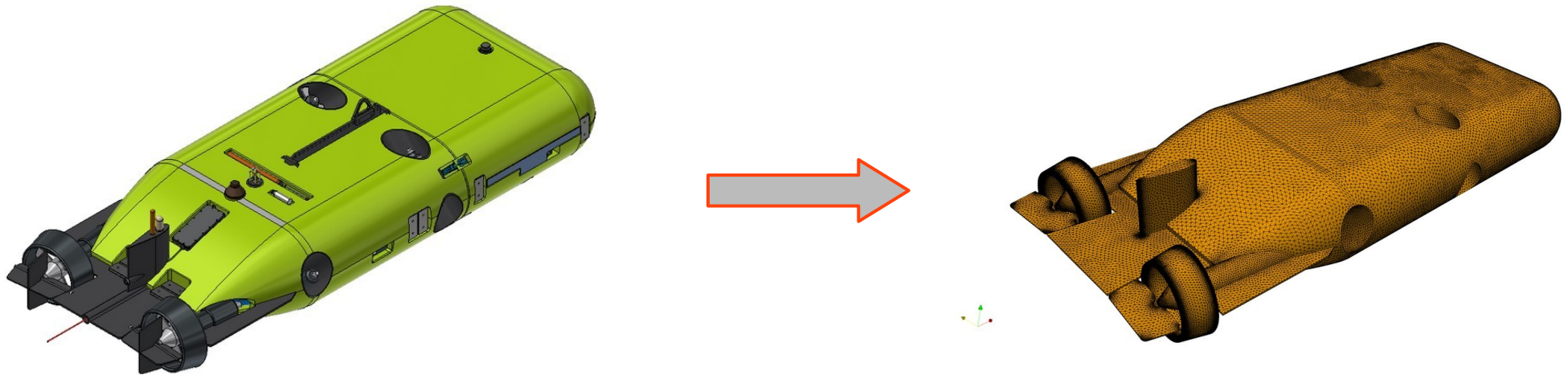
From an energetic point of view, the goal was to investigate the impact of different propulsion plants on the design. Different sub-topics were considered:

- Type of energy sources: diesels, fuel-cells, etc...
- Tests in a simulated environmental
- Analyses of the mission profiles



Overview of the Hydron-D project

This project was devoted to assessing the CFD calculations for an Underwater Drone. The project is found under PNRM in collaboration with ISME and SAIPEM.

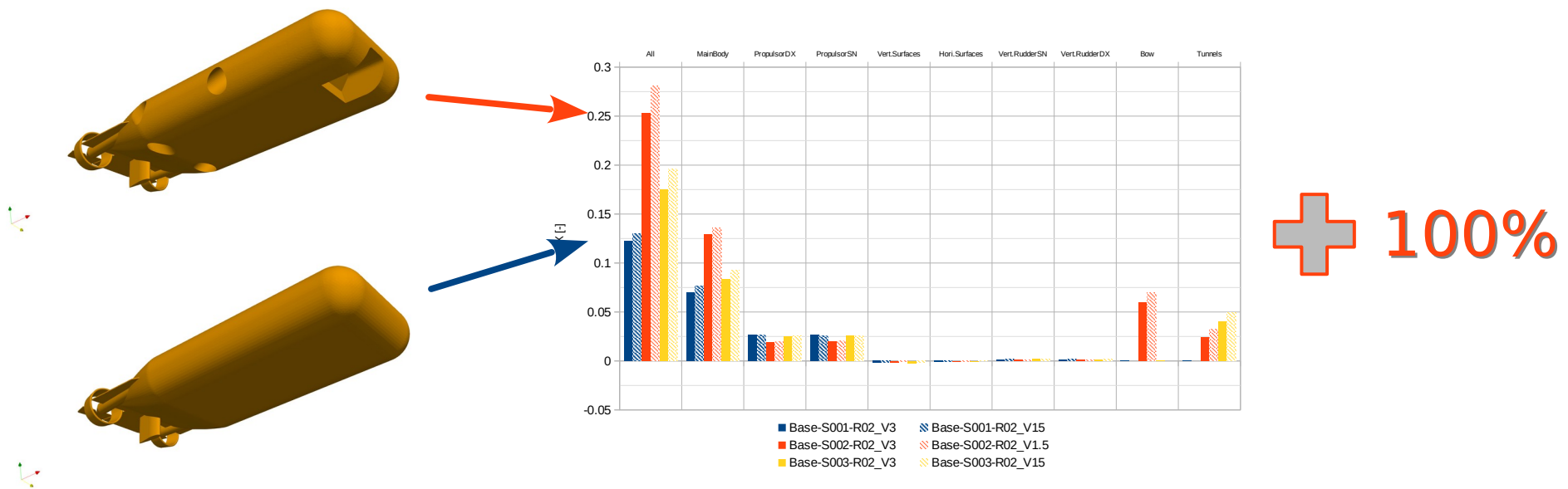


Overview of the Hydron-D project

The project focus was the characterization of the AUV from a hydrodynamic point of view.

Different aspects were investigated:

- Evaluation of the impact of the geometry on the vehicle resistance

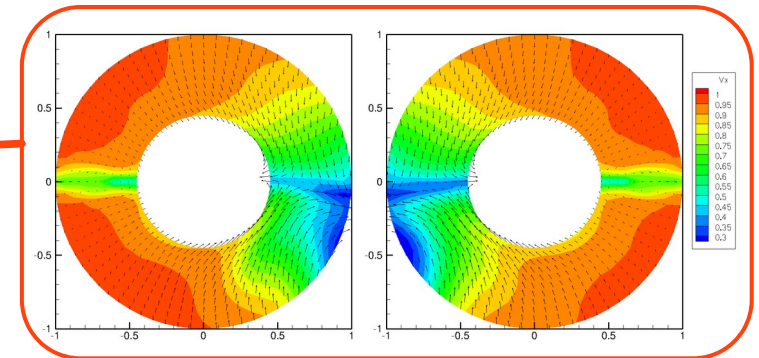
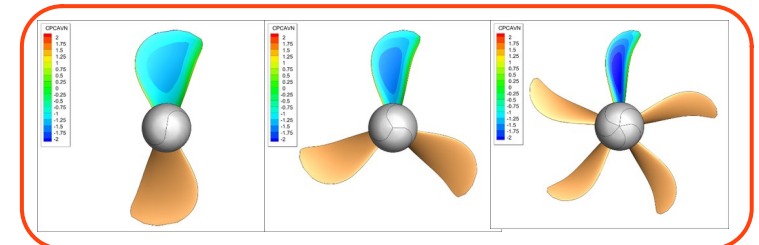
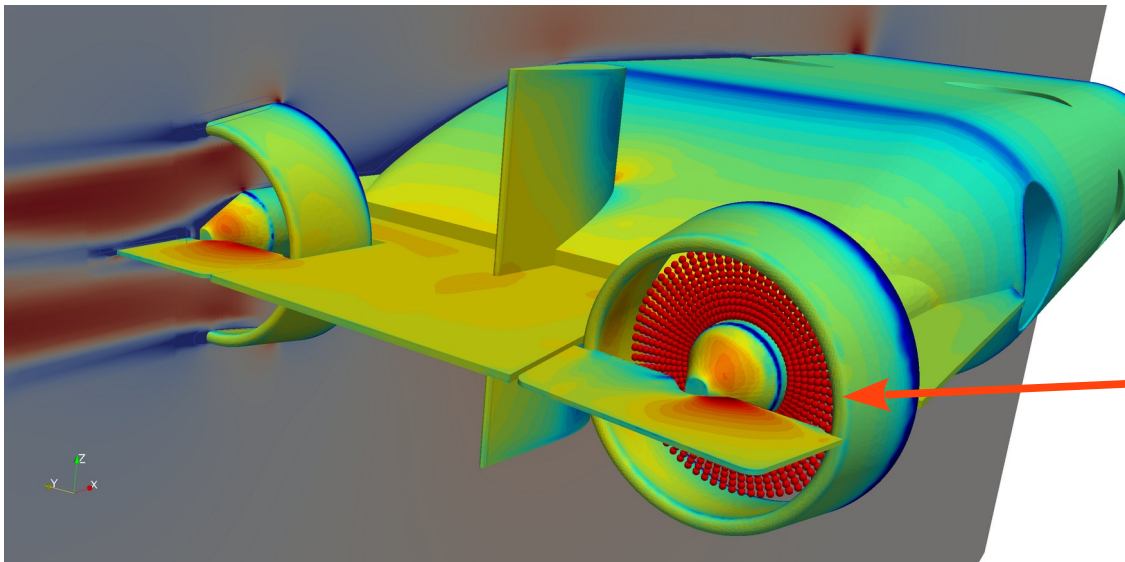


Overview of the Hydron-D project

The project focus was the characterization of the AUV from a hydrodynamic point of view.

Different aspects were investigated:

- Accurate prediction of the propeller/hull interactions

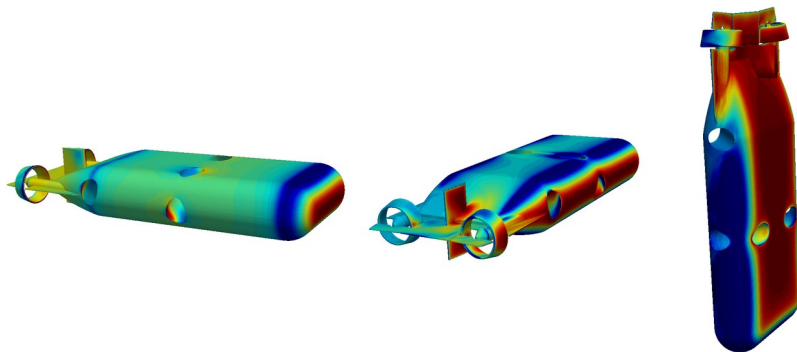


Overview of the Hydron-D project

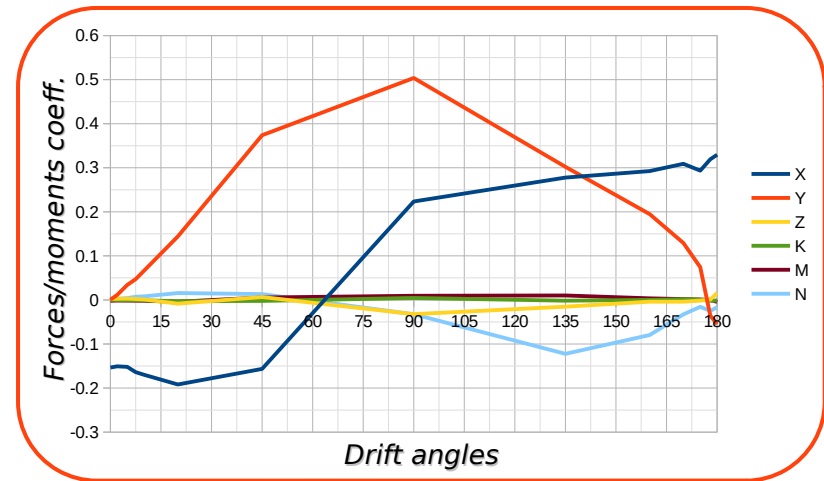
The project focus was the characterization of the AUV from a hydrodynamic point of view.

Different aspects were investigated:

- Evaluation of the maneuvering forces and moments



About 100 simulations to evaluate the force behaviors with respect to the flow directions



Overview of the Hydron-D project

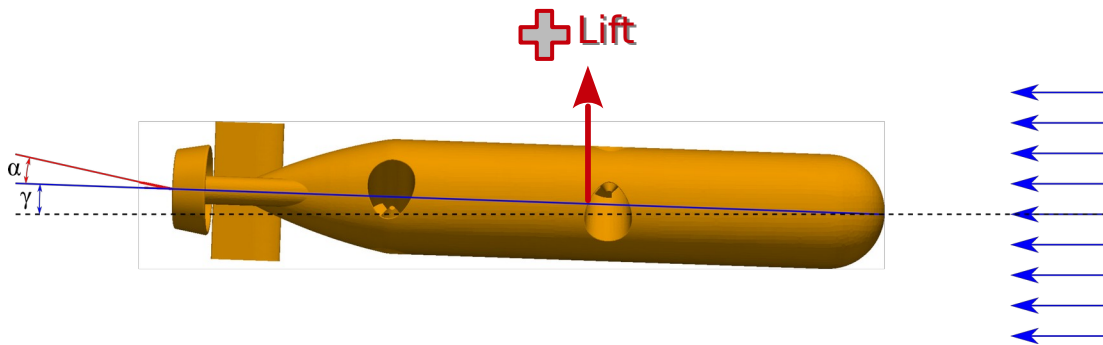
The project focus was the characterization of the AUV from a hydrodynamic point of view.

Different aspects were investigated:

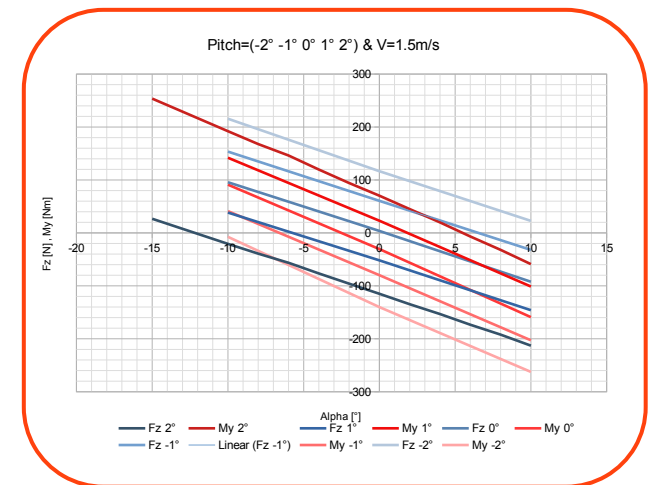
- High efficiency navigation

$$\begin{cases} F_H(\alpha, \gamma) + F_B \cdot \cos(\gamma) = 0 \\ M_H(\alpha, \gamma) + M_B = 0 \end{cases}$$

How correct the positive or negative buoyancy without active devices



Forces/moments coeff.



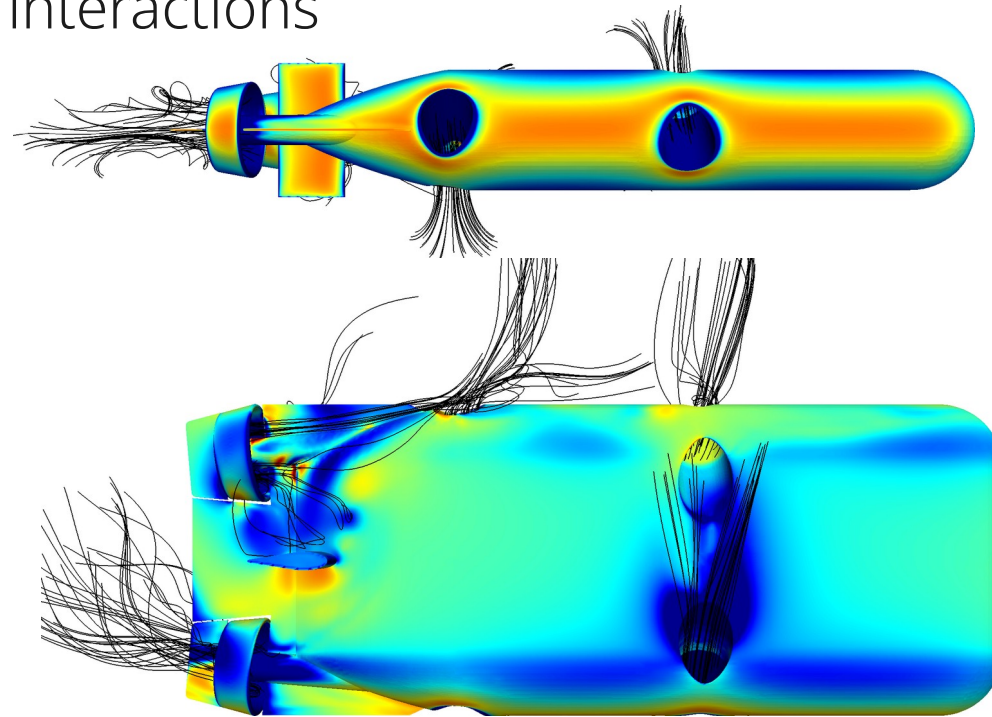
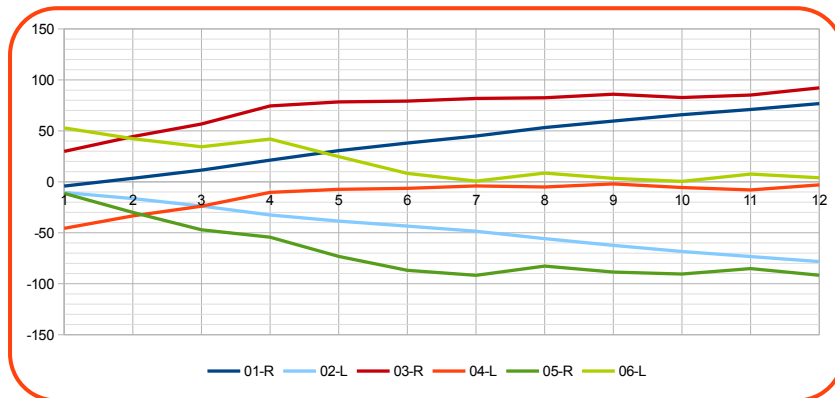
Overview of the Hydron-D project

The project focus was the characterization of the AUV from a hydrodynamic point of view.

Different aspects were investigated:

- Complex hydrodynamic propulsion interactions

Thruster forces



Future expectations

The ***Underwater Vehicles*** grow in importance in today's scenarios being a valuable technology for the exploration/surveillance/management of the ***Marine Environment*** (>70% of the globe).

