# OPTIMAL DESIGN PARAMETERS OF AUV HULL BASED ON CFD SIMULATION

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Research and management of marine and continental waters requires the development of new vehicles, devices and techniques able to explore the different habitats.
The present paper is organized in two parts: a simulation platform and a parametric design. The first one, established a series of rules for reliable calculation of the drag forces of an underwater vehicle by means
the use of tools of Computational Fluid Dynamics (CFD). Subsequently we use this platform
to design an efficient vehicle from the hydrodynamic point of view.
The simulation involved a finite element analysis the volume of water in movement around the vehicle. Are defined a water tunnel where the vehicle is positioned. Tunnels too small give unrealistic results by the effect of proximity of the tunnel's walls to the vehicle. Too large tunnels imply excessive calculation times. The experiment determined the optimal size of the tunnel in relation to the vehicle. The simulation has been made with the tool of CFD software UNIGRAPHICS NX7.5.
In the same sense, mesh size of the water influences the results, with similar consequences. Large mesh size gives unrealistic results and too little high computation time. Here also determined the optimal size of that mesh.
In the paper describe the calculation of drag forces to the hull of a vehicle with parameterized design. From experience, type design was taken as the shape of the water drop, consisting of a front ellipsoidal and the back paraboloid, with a cylindrical middle part. For simplicity, came to be used three design parameters for a constant volume. It has been considered including flaps face to recalculation of the drag forces.
Additionally we considered the effect of the apparent current around the vehicle being the angles corresponding to spherical coordinates.
With the simulations it was found that the drag force has a quadratic form with velocity, establishing a nominal velocity for the experimental and extrapolated to other velocities.
With relative to the forces is to emphasize the separation between friction and resistance to movement and pressure force on the hull.
A dynamical model has been developed using the computed forces previously obtained. Based on that, simulations showing the effect of the vehicle inside strong streams have been studied based on the distribution of loads.
Conclusions of this work had been taken into account for computing the drug forces of the vehicle shown below,
The prototype of submarine vehicle has been manufactured in compound materials using CAD/CAM/Robotics integration techniques. In addition, the same mold has been used for constructing a terrain vehicle with very good aerodynamic behavior, which is competing in the Shell ECO-marathon.
This work was supported by the Spanish Ministry inside the DIVISAMOS Project (DPI2009-14744-C03-01) with title "Autonomous Underwater Inspection Vehicle for Oceanographic Missions". The ultimate objective of the proposed project is to have an underwater autoguided and partially teleoperated vehicle, which can be fitted with various sensors and instrumentation to perform different missions, mainly for analysis of ocean waters, but also for monitoring in both the civil and military facilities. The Project covers the following areas: Oceanographic Missions, Control Architectures, Multifrequency Systems, 3D SLAM, Scan Matching, Registration Data with 3D Reconstruction and Teleoperation and Human-Machine Interfaces.
As further work, the prototype will be used for studying maneuverability, accessibility, stability and fluidodynamic resistance in addition to evaluating its functionality and mission capabilities.

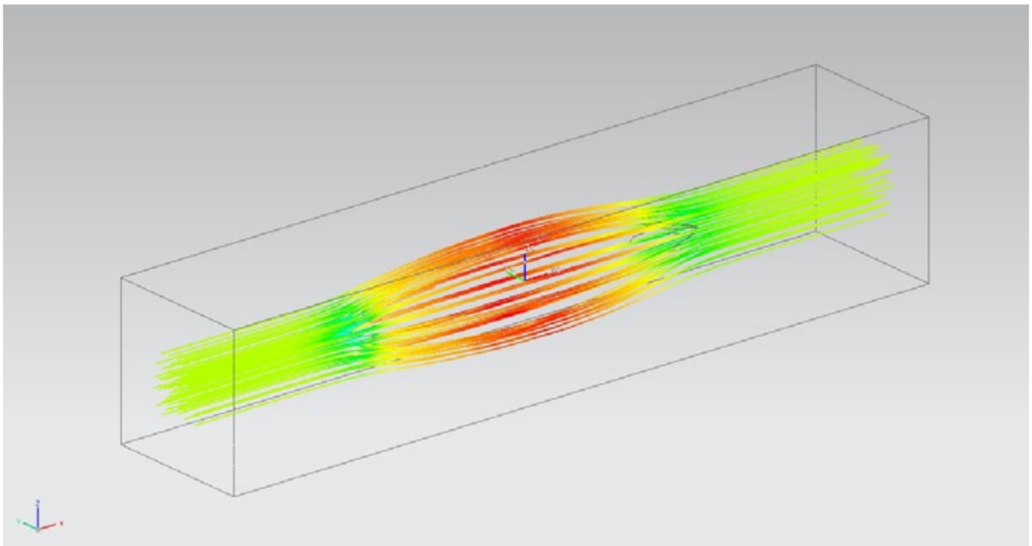

***Fig.1. CFD Analysis***


***Fig.2. Design and Manufacturing***