Conclusion

In this contribution the successfully used technology will be presented and discussed. Proposals for future developments will be made.

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DEVELOPMENT OF AN AUTONOMOUS OCEANOGRAPHIC OBSERVATION PLATFORM

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1. Introduction

In spite of the great advance in the knowledge of the Ocean obtained by means of the use of oceanographic ships and anchorages, the sampling of the marine environment is still insufficient. The limitations of the conventional oceanic platforms of observation prevent the sampling of the sea with the space and temporary density required. By such reason and with the aid of the recent technological advances the development of new oceanographic observation platforms has been tried, able to make interdisciplinary measures with a space and temporary high-resolution simultaneously.

The platforms of observation denominated Gliders, the Autonomous Underwater Vehicles (AUVs) and the Autonomous Surface Vehicles (ASVs) are born. This project proposes the development of a oceanic observation platform of low cost, hybrid between the AUVs i ASVs. The platform moves by the surface of the sea and makes vertical immersions obtaining profiles of the water column in agreement with a pre-established plan. These two characteristics of the observation platforms, will lower the production costs prices and will increase their efficiency. The superficial displacement of the platform will allow the navigation by means of GPS and the direct communication and telemetry by means of radio-modem.

2. Discussion and results

Considering that the principle design corresponds to a first prototype on which, necessarily, successive modifications will have to be made, we worked with a mechanical design constituted by a support structure on which the motors of direction and propulsion will be reconciled. This structure is not watertight, which is going to allow to make any type of mechanized.

Inside the support structure a watertight cylindrical module is reconciled that contains the immersion actuator and the electronics control, as well as the power supply batteries. The support structure is made up of a cylinder of PVC of 1.2m in length and 32cm of outer diameter. In one of the ends of the support structure the main motor of propulsion of the Seaeye company is reconciled. In the lateral ones of the cylinder individual motors of the Seabotix company are reconciled. The watertight module contains the immersion group, the electronic modules of reception of signal and engine control, and the power supply batteries. Figure 1 describes the structure of the completely assembled vehicle. The payload has settled down in about 5 kg, approximately, on a gross weight of the platform of 76 kg.

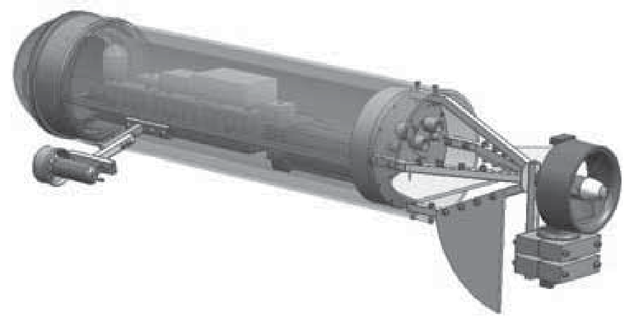

Fig. 1. Complete structure of the vehicle.

In a first stage, the control is made of manual form by means of the sending of the propulsion, direction and immersion orders from a ground station to the vehicle, using an Radio Control (R/C) equipment, as it is described in figure 2. The objective is the study and characterization of the dynamic behavior of the vehicle in aquatic environmens, with the purpose of obtaining the necessary parameters for the later development of the autonomous control.

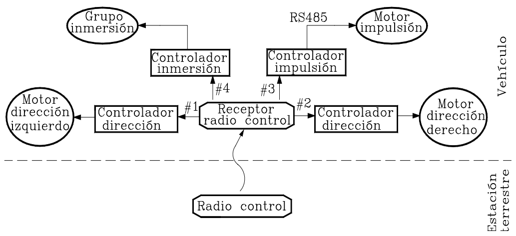

Fig. 2. Diagram of the manual control

On a second stage the control system of autonomous navigation will be developed and the necessary elements for the data acquisition of the water column will be get up during the immersions (temperature, depth and conductivity) and the security elements of the vehicle (supervision batteries status, collision avoidance systems, temperature and humidity inside of the vehicle). In figure 3 the diagram anticipated for the independent control of the vehicle is described. The communication between the vehicle and the ground station is bidirectional and industrial modem T-MOD400 of the company Farell Instruments is used. The central control of the vehicle is made by a module PC104 Vortex86-607LV.

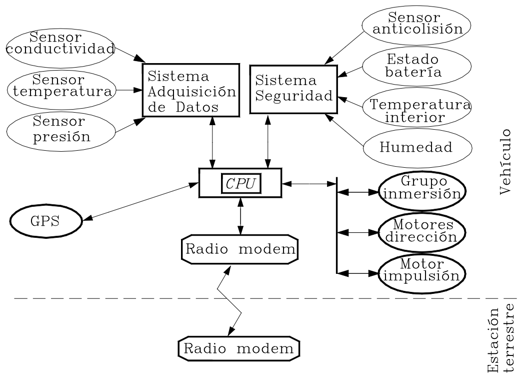

Fig. 3. Diagram of the autonomous control.

Once was verified the correct operation of all vehicle systems, in phase of manual control, we began the field work. The tests were made in a swimming pool of 25m of length, 15m of width and 2 meters of depth. The first time when the vehicle was placed into the water, see figure 4, a perfect balance adjustement was necessary. It was obtained incorporating a ballast in prow of 3.6kg and a push in stern of 1.5kg. This situation allowed the beginning of the immersion and navigation tests. In the navigation test the speed was approximadly 1,5m/s with the control of the propulsion motor at 80% of full power. The course variation is obtained very easily using the lateral motors to full power and decreasing the propulsion of the first engine. The operation of immersion was done with complete normality acting on the group motor-cylinder. Navigation in depth was successful, maintaining the course of the vehicle with good stability, direction and depth.

3. Conclusions.

The success of the vehicle test in manual control will accelerate the phase of autonomous control. The result, at this moment, is that we have a robust platform, of dimensions (1885 mm in length and 320 mm of diameter) and weight (76 kg) which is nonexcessive and it

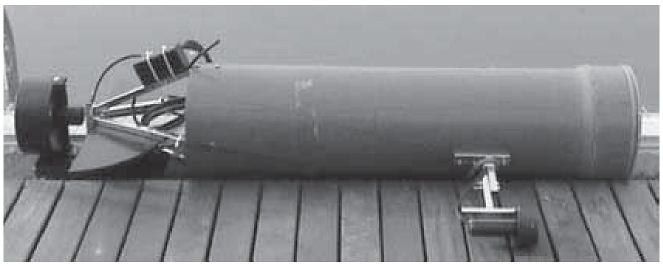

Fig. 4. Constructed vehicle.

facilitates its manageability and operativity and that we waited for behavior of remarkable form in the open sea. The autonomy of the system on the basis of NiCd batteries was poor in these first tests. It will be increased with the use of Lithium Ion Polymer cells (Lipo), once the autonomous check tests begin into the open sea. With this improvement an autonomy of 10 running hours to a regime of 60% of power of main motor is considered. As a final valuation, we can say that a low cost oceanic platform of observation has been developed which is able to navigate by the surface of the sea and makes vertical immersions to obtain water column profiles. A registry system and independent storage of high-resolution data have been developed and, finally, different ways have been studied to control dynamic nonlinear such as FPIC (Fixed Point Induced Control) and TDAS (Time-Delay AutoSynchronization).

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VIBRATION ANALYSIS AND DIAGNOSTIC IN A CATAMARAN VESSEL

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1. Introduction

In this paper the measurement and analysis of vibrations in a catamaran vessel is presented. The analysis was aimed to detect the cause of the structural damage that appears in the vesselduring its operation. Cracks appeared in sterntubenext to inlet duct and in hull next to sea water discharge pipe.

The vessel had four water jet pumps, two on each side, powered by variable speed internal combustion engines. The impeller takes sea water through an inlet duct in the bottom of the vessel and creates an output water jet that propels the unit [1][2]. A deflector behind each jet serves to control the vessel operation.

This analysis was used in the litigation that the owner of the vessel put against the constructor [3].

2. Experimental measurement

A series of vibration and pressure measurements on the vessel were carried out. The goal of the measurements was to determine possible harmful levels that could be the origin for the appearance of cracks and failures in the mechanical parts of the propulsion system.
Vibration and pressure measurements were carried with the vessel standing still and sailing at different operating speeds with sea in calm conditions. The vessel was operated with the clutch off at an engine rotating speed of 500 rpm and with the clutch on at the same speed. Then, engine speed was increased and readings were taken at around 1000, 1200, 1500 and 2000 rpm's. Start-up and coast down transients were also recorded.

The overall vibration levels and vibration signatures were calculated.

3. Results and Discussion

The vibration signals were analysed using several methods from spectral analysis to transfer functions between structure and fluid-flow (Fig. 3).

The different phenomena that could produce excitation forces on the structure were identified and studied [4]. The most important were the rotor-stator interaction, the cavitation and the turbulence generated by the operation of the pump [5][6]. The structural response was also analysed.

The origin of vibrations was determined. Vibrations in water jet room were due to the -Centrifugal pump Internal combustion engine IC