MANATI - Autonomous Underwater Vehicle

Institution/Company name	SEA TECHNOLOGICAL CENTER (CETMAR)
Contact details	C/ Eduardo Cabello s/n 36208 Bouzas, Vigo (Pontevedra). Spain. Rosa Fernández rfernandez@cetmar.org +34 986 24 70 47
Website	www.cetmar.org

□ Key words

Advanced engineering (including robotics / control systems) - Communications - Data management - Materials / fabrication / assembly - Satellite Navigation - Sensors / instrumentation / electronics - Software engineering / development

□ Description

MANATÍ is an **Autonomous Underwater Vehicle (AUV) to be applied in the management in multiple missions: acquisition oceanographic data, bathymetry, submarine mapping, underwater images, underwater security, transport information, animal tracking, spillage monitoring, or dredging operations monitoring**. This AUV is equipped with several sensors which measure the impact of those operations in the marine environment.

The MANATÍ AUV is lightweight and easy to use, with a highly configurable modular structure, whose batteries and internal components can be easily replaced on mission without putting on risk the sealing conditions. It has a fiberglass shell composed of assemblable parts. The shell's interior gets flooded when the vehicle submerges, hence, flotability is not affected. The external profile has been conceived for hydrodynamic and structural strength and protection of the rotors from direct exposure to objects. The profile has proven its reliability by computational tests of fluid dynamics (CFD).

Fig. 1. Explode design

Internal components are located in watertight boxes of PVC for ease production and maintenance operations. The propulsion system (magnetic coupling thruster system and

hydraulic buoyance system) has been developed entirely seeking optimum performance at a cost effective.

Several versions for the AUV bow have been tested, which permits to configure it for several different functions: sampling, monitoring of hydrographic parameters, video recording, side scan sonar or simply navigation. A multiparametric (SBE37 probe, eureka manta2) could be integrated in the bow, and accompanied by a sampling tube. Another configuration has an illumination system and a webcam to get underwater images. The webcam is protected in a sealed Perspex window. Finally, to be able to use the side scan sonar, the original profile of the navigation bow is kept and the side scan sonar is housed in the bottom of the AUV body.

Concerning the electronic and software design, the electronic of the AUV has a high capacity process component and a sensors and actuators access component. Both components can be changed and extended without modifying the control software. The first "high capacity process" block has been expanding ARM cortex A8 a 700 to a 1.2 GHz AMD T40 (with Debian GNU / Linux operating system) and in the other component has been changed from a ATMEL Cortex Mega2560 to a Cortex A4. The connections of the peripheral devices and the vehicle control are centralized in the sensor board. Eight packs of high-energy capacity and low-weight lithium polymer batteries supply two independent power lines at 24V and 12 V, which are distributed through a powerboard. Communications include an Ethernet cable connection and several different-range radiofrequence systems: Wifi, XBee, GPRS, Iridimum. These systems enable the sychronization with a database on a remote server when the vehicle emerges. The storage of bulky data such as video or sonograms can be done on a SD card of 8Gb (update to a SSD 128GB). The control system is programmed in Python. This programming language is easy to use and presents a number of features which are particularly suitable for any mission, like multiprocessing easy programing or a large repository library covering a wide range of functionality. This system is going to be integrated in the Robot Operating System (ROS) , a set of software libraries and tools, in order to improve the capacities of the AUV.

When the AUV is at surface, the AUV communications allows sending the vehicle status, battery level, and even some sensor data from the AUV to the mission control computer onshore or on a boat. Low-level decisions, such as "speed up" or "turn," are order by the computer and software on the AUV, but operators can transmit higher-level decisions, like "stop" and "come home." Operators can also change the survey area while the AUV is at surface. This software is based on Ardupilot software included in the new dronecode version. Besides, a "Mission planning" application is under development. It allows collecting and analyzing external information, resources and requirements. It permits the interactive generation of the mission timeline, and the planning of the on-board tasks during the cruise.

- **Applicability of Technology to Maritime SMES**

This AUV is suitable for use in huge variety of sectors such as the dredging, marine works, marine renewables and public administration sectors.