Oceanographic Buoy Expands OBSEA Capabilities

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Abstract – On this paper, the electronic system and oceanographic instruments of a moored buoy are presented. The system has been designed by the SARTI research team to meet a very specific objective, which is to expand the capabilities of the underwater observatory OBSEA as a research and test platform, providing an infrastructure for testing instruments either at the seafloor or at the surface. The system currently has a meteorological station, a video camera and a 3G modem for telemetry, in addition to a connection to OBSEA and expansion ports for connecting other systems for tests.

Keywords – Oceanographic Buoy, Ocean Test bench, Telemetry, OBSEA

I. INTRODUCTION

Moored buoys are important oceanographic observing platforms for monitoring different variables of the water column and the seafloor [1]. For these reasons, the SARTI research group (UPC) [2] has designed an oceanographic buoy for expanding the capabilities of the observatory OBSEA [3]. OBSEA (www.obsea.es) is an underwater cabled observatory located at a depth of 20 m, 4km offshore of Vilanova i la Geltrú (Barcelona), and it started its operation in May 2009 as a test bench infrastructure for research on marine sensors and instruments, and to provide a wide variety of oceanographic real-time data to scientist, academics and general public.

The SARTI moored oceanographic buoy was deployed in May 2011, and currently it serves as a platform for testing instruments and making oceanographic observations at the surface level and below water. Its cabled connection with OBSEA makes it a flexible infrastructure for marine observation, and it takes the advantage of the OBSEA data management and network control.

The buoy has different instruments, for instance, a meteorological station that provides weather information, as ambient temperature and wind speed. Also, there are instruments for measuring the pitch and roll due to waves and tides. In addition to these instruments, there is a video camera for surface observation, and on the sea bottom, there is an AWAC, which for test purposes has been connected temporally to the buoy telemetry system.

This paper addresses the description of the onboard systems and basic operation. On Section II, a general description of the system is presented. Sec. III describes the mooring system design, and Sec. IV shows some of the measurements obtained. Final section corresponds to the conclusions.

II. SYSTEM DESCRIPTION

The SARTI oceanographic buoy has offered an opportunity to extend the research infrastructure capabilities of the OBSEA observatory. The requirements to meet were to provide a system that can work either autonomously or connected to the OBSEA main power energy system, to provide telemetry of onboard sensors, and to afford a large payload for future experiments were weight may be an issue.

The buoy has the shape of a long tube 1 m in diameter and 6 m long. On the top it has a passive and active signalling in accordance with current regulation: a Saint Andrew's cross, a night-light flash, a radar reflector, and it has been painted in yellow with property marks.

A) Instruments and Telemetry

The electronic system has been divided in two main parts. One consists on a night-signalling light based on LEDs, with two dedicated solar panels and one battery power supply, being independent from the rest of the system and packed on its own water-tight box. This system has been located on the upper part of the buoy to improve its visibility, as shown in Fig. 1.

The second part of the electronic system contains the power supply, the oceanographic instruments, and the communications and control system. The energy stage consists on four 25 watts solar panels, which are used to charge a 12V battery with 60Ah capacity, which in turns powers the entire system under autonomous operation.

Currently, the onboard oceanographic instruments are a meteorological station, a GPS, and a video camera. Nevertheless, the system has the capacity to be connected to more instruments through a Serial/Ethernet extension port. At this time, on this port a Doppler current-meter, an AWAC (integrated Acoustic Waves And Currents sensor), located on the seafloor, has been connected to the buoy for telemetry. Fig. 2 shows the AWAC ready to be installed.

B) Control Unit

The rest of the electronics are a 3G modem that provides real-time telemetry and a microcontroller for system control and power usage monitoring. All these elements have been packed into two water-tight boxes, one for the battery and the solar charger, and the second one for the 3G modem and the control unit. The video camera has its own enclosure with a transparent screen, located at the top of the buoy, as shown in Fig. 1.

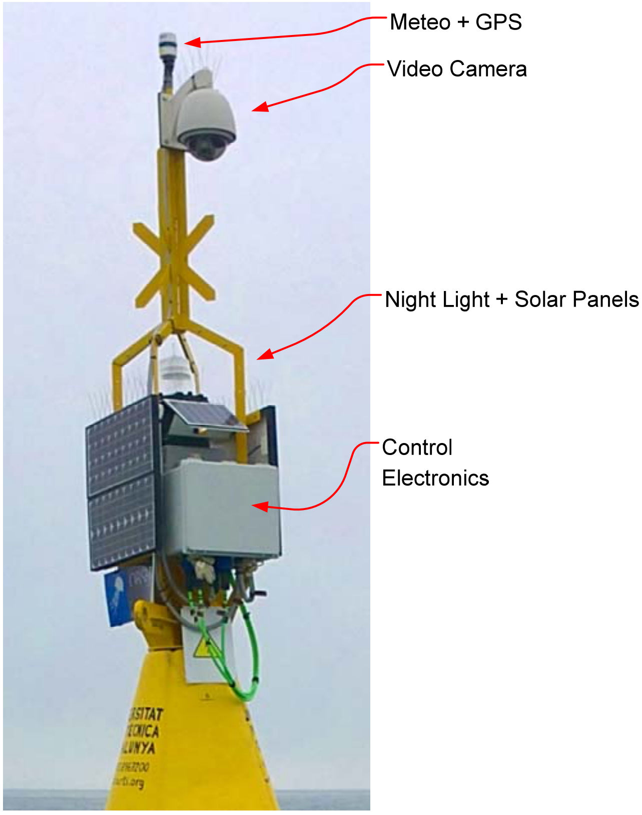

Figure 1. Buoy and instruments

Because the buoy has been planned to work also as an autonomous system, powered by solar panels, it is possible to set different operating conditions for day and night operations. For this purpose, the control unit also monitors the power consumption of the system. The onboard systems have been tested under the following conditions: continuous operation during day light; and partial operation during the night (50 min off and 10 min on).

Figure 2 AWAC ready to be installed

III. MOORING SYSTEM

The SARTI buoy has been located next to OBSEA, and its mooring system consists on three anchors of 1200 kg connected with chains to the buoy. The position, the distances between them, and the chains behaviour was studied and simulated as a preliminary work [4], where marine conditions of the area of Vilanova i la Geltrú coast were taken into account.

Figure 3 shows the simulation of the system using OrcaFlex 9.4, where it is possible to observe a "star" configuration, which provides position stability and prevents rotations, which is interesting for some experiments and measurements, as the onboard video camera.

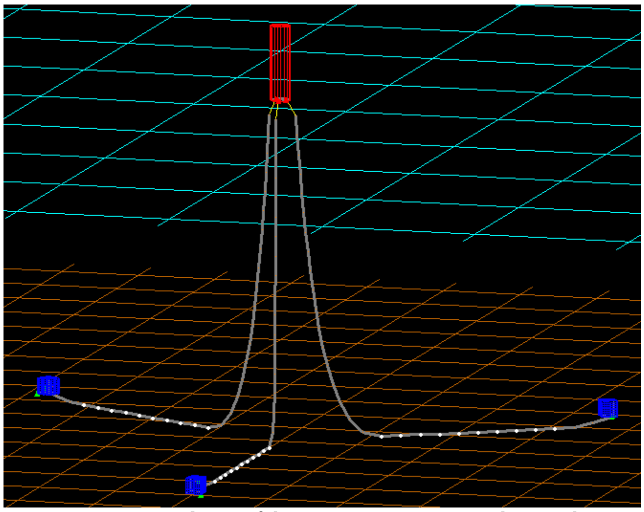

Figure 3. Simulation of the Mooring system using three anchors.

IV. MEASUREMENTS

A) Temperature and Wind Speed

The meteorological station installed on the buoy measures the ambient temperature and the wind speed. On Fig. 4 and Fig. 5 it is possible to observe the graphics of these variables for a period of 24 hours. On this period, the buoy was operating in the autonomous mode, and it is possible to see that during the day there is continuous data, while after 7pm until 6am data arrives at a rate of 10 min every hour; this shows the low power consumption mode (50 min off and 10 min on).

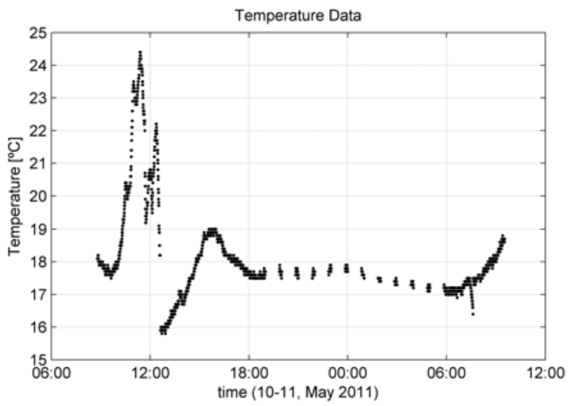

Figure 4. Temperature

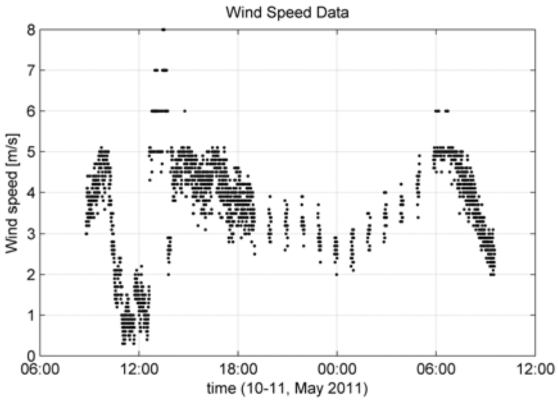

Figure 5. Wind speed

The AWAC and the buoy have been tested for autonomous operation for 6 weeks, using a dedicated pack of batteries for the AWAC. Fig. 6 shows the usage of the battery pack during this period. For this same time of test, Fig. 7 shows the AWAC's measurements for the sea current-speed measured at different depths.

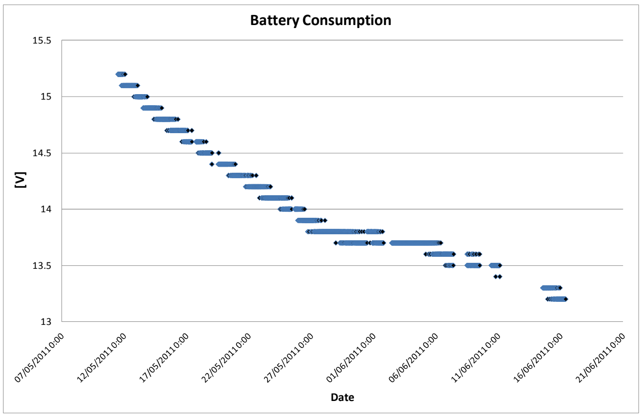

Figure 6. AWAC battery consumption for 6 weeks

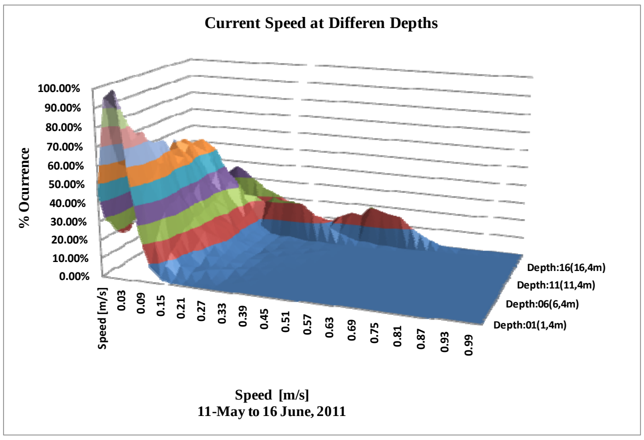

Figure 7. Sea current speed at different depths measured with the AWAC.

V. CONCLUSIONS

The characteristics of an oceanographic buoy have been presented, providing details of the onboard systems. The buoy has different sensors, a video camera, and a redundant telemetry: via a 3G modem or through OBSEA network. As an additional feature, its solar panels also allow electrical power autonomy for standalone operation, in case it is disconnected from OBSEA.

The buoy is an extension of the OBSEA underwater laboratory, providing a surface platform for oceanographic measurements and also as a test bench for testing marine sensors and instruments, taking the advantages of OBSEA infrastructure and connectivity. Its design has considered also the mooring system, which has been analyzed using simulation software before the buoy deployment.,

VI. ACKNOWLEDGEMENTS

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