HIDROBOYA: A COMPLETELLY NEW WAY OF OVERCOMING THE FOULING PROBLEM IN MARINE SENSORS

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This communication presents Hidroboya (r), a buoy that is already working on the sea and whose purpose is being an autonomous source of ocean and land water data that will be automatically sent to an "on land" server which organizes them in a database system. Server can handle information from several buoys and authorized users can see and browse data over the internet. Furthermore, buoy sensing design is very innovative, because it keeps sensors dry the most of the time and use a hydraulic system to feed fresh ocean water to them when required. This design keeps sensors free from sea particles sedimentation, problem known as "fouling".

GENERAL OVERVIEW

The buoy main part is a strong hose hanging from a floating body. The hose contains several sampling catheters which are used to get water from different depths (as these tubes go out from the main hose and finish at the desired sampling depths). The main hose is securely bound to the anchor chain in one or more points to avoid excessive hose movement.
The sampled water will go through a "sampling chamber" located in the castle over the floating body. Sensors inside the chamber will get the desired data from the sampled water and the obtained parameters will be transmitted to an "on land" station that will save them on a database system. These data will be available to all authorized users through a Web application.

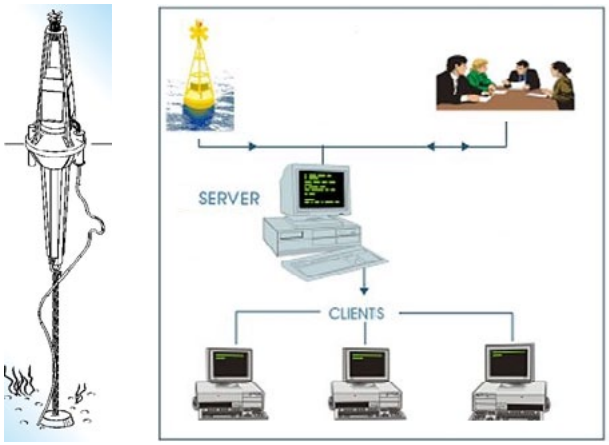

Fig 1.Buoy and "on land" system

SENSING DESIGN

Main originality of this buoy is the special sensor arrangement. In classical systems, sensors are directly contacting sea water and they soon became polluted (fouled) by particle sedimentation. Nevertheless our buoy keeps sensors dry when they are not being used so that they are not affected by fouling. Due to this we have longer sensor life and less maintenance needs.

BUOY CONTROL AND INFORMATION HANDLING

Buoy has an on board control system that consists of the following:
- Sensor reading system : sensor outputs are converted into a normalized digital stream.
- Communications system : based on GPRS and/or UHF radio modems and/or satellite data communications. It is used to send the data stream to the land station. If the buoy is located near the coast line, GPRS usually can be used (coverage on the sea can reach the order of 20 Km). A satellite link orUHF radio modem must be used as a secure redundant system or if the buoy is far from the coast line. Commands to the system can also be sent from the land station.
- Data saving system : buoy saves all retrieved data in a kind of "black box" that could be recovered after a catastrophic event.
- Water filling control : the sensor chamber must be filled with water when we want to take data and water must be removed after that. We get this with

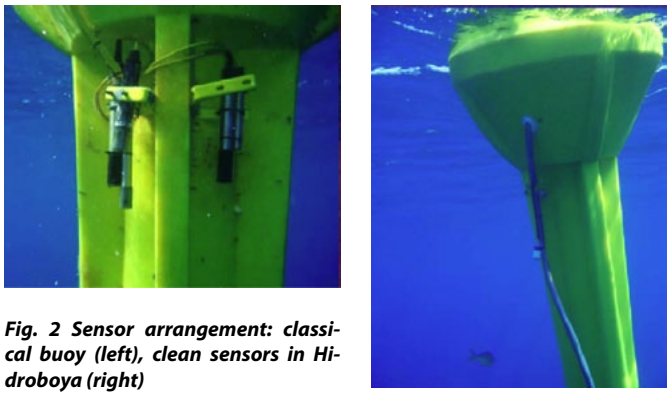

Fig. 2 Sensor arrangement: classical buoy (left), clean sensors in Hidroboya (right)

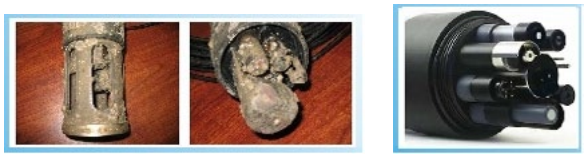

Fig. 3 Fouling in a classical buoy (left), clean sensors in Hidroboya (right)

pumps and solenoid valves controlled by the buoy intelligent control system. We also use auxiliary sensors to control water filling.
On land, data are saved on a database server that permits accessing them through a Web interface. With this system we can monitor water conditions in many interesting circumstances: pollution control, bath water quality in touristic areas, control of mollusk farming zones, etc.

POWER SYSTEM

Buoy batteries and solar panels are used for power needs and in the currently installed system (see next section) this has proven to be enough as this installation is located in a very sunny place. Nevertheless we are developing other alternatives to generate power:

- We tested a generator that uses sea waves to create an air current and move a small generator. This idea needs to be analyzed in more detail.
- We are now studying the possibility of using wind generators and other ways to obtain energy from the buoy movement.

RESULTS

A first commercial buoy is already working in Granadilla, Santa Cruz de Tenerife (Canary Islands, Spain) where a harbour will be constructed. The buoy is retrieving data from October 2010. This buoy has installed a multi-parametric sensor that measures: temperature, pH, electrical conductivity, redox, turbidity and solubilized oxygen concentration. This system performs samples on three depths. 1 meter, 7 meters and 14 meters. The data from the buoy can be accesed in real time in [9]

Hidroboya is right in the line pointed by the Water Framework Directive [7], about controlling different waters quality (bath, rivers, Marine Environment and Coasts, drinking water, water pollution, etc). It uses the technologies pointed by [8] to construct the framework for Marine medioambiental observation and control.

An U.S. patent has been requested for this system with application number 61224557 and title "Autonomous and Remote-Controlled Multi-Parametric Buoy for Multi-Depth Water Sampling, Monitoring, Data Collection, Transmission and Analysis".

FUTURE LINES

The main efforts in development are nowadays directed towards:
- Development of a new subsystem able to capture water samples that could be retrieved by a boat and analyzed in the laboratory. This could be used to research further when some indicators reach worrying values.
- Developing new energy systems to improve buoy autonomy (see section IV 'Power Systems').

OPERATIONAL OCEANOGRAPHY

Operational Oceanography is a developing area that needs to be fed with oceanic data, in order to produce continuous information. These data can be obtained from Remote Sensing (Satellites) [CREPAD] but these data need to be combined with data from the column of water taken directly form the sea or continental. Infrastructures such us [CREPAD] can help the whole society to have a better knowing about the ocean and continental waters state. It will help in a more efficient use of our waters and coastal profitment.

HIDROBOYA INTEGRATION IN OPERATIONAL OCEANOGRAPHY

The development of the Hidroboya has been done looking for an effective way to avoid the fouling in the directly exposed sensors to the water. Overcoming the fouling problem let Hidroboya to have very large maintenance intervals. The sensors are protected on board of the buoy. This brings the possibility of self calibration of sensors enlarging even more the maintenance intervals. These facts make the hidroboya ideal to be used to fed data for the numerous projects of observation of the sea and of the continental waters [1], [4], [5] [6] ... .

We firmly believe that the Hidroboya can suppose a before and an afterwards in the systems of measure of parameters directly in the waters [1].

In the information from leading companies devoted to this market, it can be observed that all the available solutions are traditional systems that in no case surpass the enormous problem of the fouling [2], [3],... .

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Sarmiento de Gamboa, CSIC's science vessel loading a sheep