

An aerial photograph of a coastal city, likely Cádiz, Spain, with a red and blue color scheme. The city is built on a peninsula, with a large body of water to the left. The text 'INSTRUMENTATION VIEWPOINT' is written in large, bold, white letters across the top. The text 'number 11' is written in smaller, white letters to the right of the main title. A horizontal line is drawn below the title.

INSTRUMENTATION VIEWPOINT

number 11

Autumn 2011

MARTECH 2011

Fourth international workshop on marine technology
September 22th - 23th, Cádiz

CÁDIZ ●

Head Office

SARTI Technological Development Centre of Remote Acquisition and Data processing Systems
Technical University of Catalonia (UPC)
Rambla Exposició 24 08800 Vilanova i la Geltrú (Barcelona, Spain)

Member of: Xarxa de centres de suport a la innovació tecnològica (Innovation Network). TECNIO.

ISO 9001:2008 Accredited by: Det Norske Veritas

Publisher/Editor: Antoni Mànuel Lázaro

Editorial Board: Antoni Mànuel, Miguel Bruno Mejías, Joaquín del Río,

Associate: Alfonso Carlosena (UPNa), Juan José Dañobeitia (CSIC), Joan Martí (CSIC), Francesc Sardà (CSIC), Rogelio Palomera (UPR), Helena Ramos (IST), Gerard Olivar (Universidad Nacional de Colombia), Miguel Bruno (UCA), Águeda Vázquez López-Escobar (UCA)

Production/Design: Alberto Martínez and Iris Santamaria

Language adviser: Shahram Shariat Panahi

Collaborations: Proceedings Instrumentation Viewpoint 11 extended abstracts.

Paper Version:

ISSN 1697-2562

DL B-51.702-03

Electronic version:

ISSN 1886-4864

DL B-32814-2006

This publication has been designed using Adobe Pagemaker, serial number 1039-1413-9288-5774-8172-4630

Cover: DEIMOS Satellite image courtesy of Isabel Caballero, Aurelio Martí, Águeda Vázquez, Raúl García, Jesús Gomez-Enri, Javier Ruiz and Gabriel Navarro-

Picture collaborations: Ramon Margalef, OBSEA web camera

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The acceptance of the articles presented depends on their scientific quality and their adaptation to magazine's editorial line.



As in previous editions, the present issue of Instrumentation Viewpoint is devoted to the communications presented in the 4th edition of MARTECH WORKSHOP which will be held in the city of Cádiz on September 2011.

As in previous editions, MARTECH 2011 has been opened to all research groups working on the development of marine technologies and applications as well as companies involved in this field interested in display their products and developments.

As a novelty MARTECH 2011 expands the topics covered in previous editions in order to address issues related to operational oceanography systems, new technologies for renewable marine energy and the technologies related to the offshore aquaculture.

We sincerely hope, that the 77 contributions that you will find in the next pages provide you information of your interest.

Warm Regards,

MIGUEL BRUNO MEJÍAS
Organizing Committee Martech 2011

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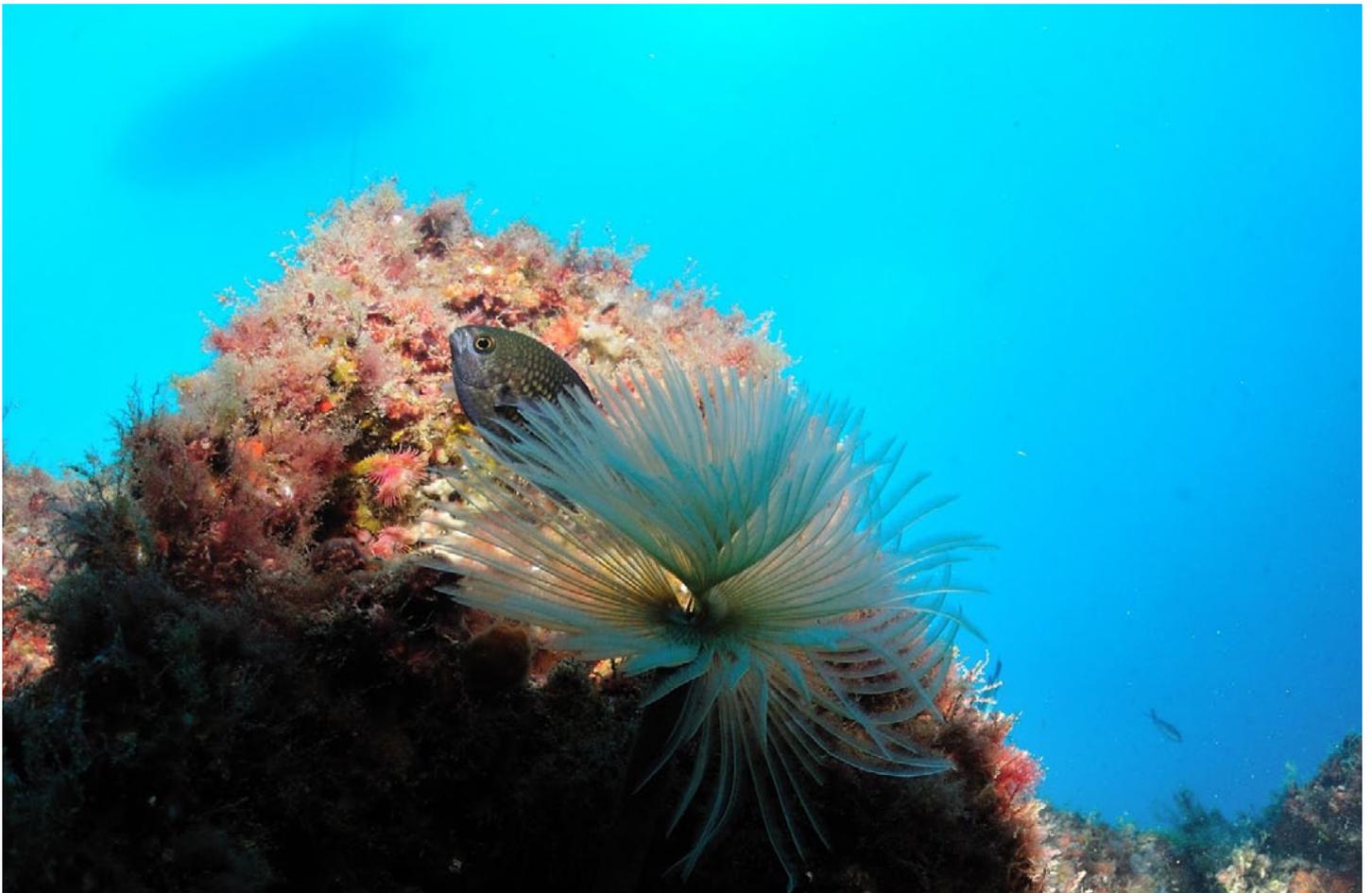
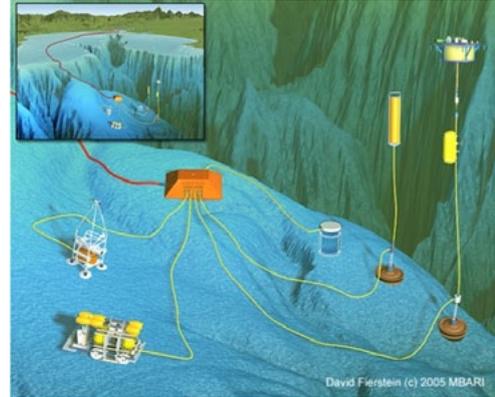
MARS (MONTEREY ACCELERATED RESEARCH SYSTEM) AN OPERATIONAL OCEANOGRAPHIC CABLED OBSERVATORY

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The world ocean is in crisis. Evidence abounds that global climate change is turning the ocean more acidic; oxygen minimum zones are expanding, anoxic dead zones are appearing in formally rich fishing grounds around the world and threaten the ability for the ocean to support human life. Additionally, the rapidly melting polar and Greenland ice may threaten the global thermohaline circulation. The threats to human populations are evident.

Understanding ocean processes are critical and oceanographers require a persistent ocean presence to understand the complex and dynamic ocean. To achieve a persistent ocean presence, advanced nations around the world are considering ocean observatories and low cost free sensor arrays to supplement oceanographic ships.

MBARI (Monterey Bay Aquarium Research Institute) supported by the US NSF (National Science Foundation) have contributed to the ocean observatory effort by building MARS (Monterey Accelerated Research System) a cabled test bed observatory.



Underwater life. Picture taken by Ramon Margalef.

AN INTERNATIONAL PERSPECTIVE ON MARINE RENEWABLE ENERGY

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Abstract – Climate change and increasing dependency on imported energy by many countries require an ambitious development of renewable energy sources. The marine environment represents a huge potential for harnessing different renewable energy resources. There is a wide range of marine renewable technologies being developed and deployed worldwide.

The most advanced technology is offshore wind with around 3GW of installed power in Europe at the end of 2010 and increasing annual rates of growth. At present the deployment of offshore wind parks are based on large wind turbines fixed structures such as monopiles, tripod and jackets in shallow water up to around 50 m water depth. In many parts of Europe such as France, Spain, Portugal and Norway, there are significantly larger offshore wind resources available in waters deeper than 50 m but still relatively near to the shore. In other relevant markets worldwide such as the US, Canada and future markets on the Southern hemisphere, the continental shelf is even smaller and floating technology is the key to the offshore wind market takeoff.

Wave power captures kinetic and potential energy from ocean waves to generate electricity. Wave energy converters (WECs) are intended to be modular and deployed in arrays. At present there is little design consensus for wave energy devices with no industry standard device concept. Due to the diverse nature of the wave resource it appears unlikely that there will be one single device concept that is used, rather a small number of device types that exploit different regions of this vast resource. There are no commercial wave power plants to date but several prototypes at different stages of development. These prototypes are based on different concepts which can be classified into the following types:

- Attenuator devices are generally long floating structures aligned in parallel with wave direction, which then absorb the waves. Its motion can be selectively damped to produce energy.
 - Overtopping devices are wave surge/focusing system, and contain a ramp over which waves travel into a raised storage reservoir.
 - OWC (Oscillating Water Column) devices, in which a column of water moves up and down with the wave motion, acting as a piston, compressing and decompressing the air. This air is ducted through an air turbine.
 - Point absorbers are floating structures absorbing energy from all directions of wave action due to their small size compared to the wavelength.
 - Oscillating Wave Surge Converters extract energy from the surge motion in the waves. They are generally seabed mounted devices located in nearshore sites.
- Tidal Current power captures the kinetic energy of the moving water of the tide. Several different tidal current energy converter device technology concepts have been proposed and developed in recent years. The main differences be-

tween concepts relate to the method of securing the turbine in position, the number of blades and how the pitch of the blades is controlled. Tidal current devices are generally modular and intended for deployment in 'arrays' for commercial use in order to obtain a significant combined energy output (similar to the onshore wind approach). There are no commercial plants with tidal current devices so far, however the technology has converged more than for wave energy with several full scale prototypes installed, most of them based on horizontal axis turbines.

Tidal Range (or Tidal Rise and Fall): Tidal energy can also be captured based on the potential energy of the difference in the height of water at high and low tides. Technologies such as tidal barrages are used to convert this energy into electricity. The largest ocean energy installation in the world, with a power of 240MW, is based on this technology and it is located in La Rance, France.

Ocean Currents are the constant flows of water around the oceans. These currents always flow in one direction and are driven by wind, water temperature, water salinity and density amongst other factors. They are part of the thermohaline convection system which moves water around the world. Ocean current energy technologies are being developed to capture the kinetic energy carried in this constant flow of water. The primary design concepts for ocean current energy are based on water turbines.

Ocean Thermal Energy Conversion (OTEC) is a technology to draw thermal energy from the deep ocean and convert it to electricity or commodities. This technology requires a temperature difference of 20°C between the warm surface water and cold deep water and as such is only possible in certain areas of the world; the tropics are the key area for this technology. The key uses for OTEC are to generate electricity, desalinate water, provide refrigeration, and support mariculture.

Salinity Gradient power is energy from the difference in salt concentration between fresh water and salt water. As such, this can be exploited at the mouth of rivers where fresh water meets the saline water. There are two technologies being developed to convert this energy into electricity: pressure-retarded osmosis and reverse electrodialysis.

If costs can be reduced to a competitive level, the potential for marine renewable energy in deep waters is huge. One way of reducing costs is to exploit synergies between different technologies. One effective choice is to combine offshore wind with wave energy or ocean/tidal currents at sites where these resources are concentrated. Because of the different characteristics of these resources, they offer substantial additional benefits compared to the simple addition of more wind capacity. These benefits could be even bigger if other uses such as aquaculture are also considered, establishing a new concept of multiuse offshore platforms.

NODE AND JUNCTION BOX SERVICES AND INTERFACES FOR A LOCAL SEA BOTTOM OBSERVATORY

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Sea bottom observatories, based on a submarine cabled network, are designed to collect, at high frequency and in real time, valuable data over a long period of time (up to 25 years), they are used in many multidisciplinary research projects including geophysics, chemistry, biology and physical oceanography... they provide an end-to-end service; from the sea bottom to your computer.

The main differences between a local and a large scale cabled network are the backbone specifications linking the shore station and the nodes on the seafloor. Power and voltage must be compatible with a long distance to connect on the network a large number of instrumentation.

This simplified and optimized design for a local sea bottom observatory provides the same infrastructure, services and interfaces for the instrumentation connected to the junction box as a large scale cabled network: trawl resistant frame, corrosion and fouling resistant design, maintainability, nodes and junction boxes, wet mateable connectors, various voltages and data interfaces, network extension (optical or VDSL2), time synchronization (NTP, PTP 1588v2, NMEA PPS), embedded controller for monitoring internal parameters and science ports, fail over, redundancy, network management protocol, remote control and supervision.

We describe in this paper how can we optimize the design and reduce the cost of such a local or coastal network, without jeopardizing the reliability of a submarine network.

This architecture will be deployed later this year on a marine conservation area near Brest, France for the MeDON project. MeDON has been selected within the scope of the INTERREG IV A France (Channel) - England cross-border European cooperation program, co-funded by the ERDF.

All these recommendations, specifications, interfaces are based on the ESONET/EMSO label to ensure compatibility and interoperability between sea bottom observatories in Europe.



Figure 1 - MeDON - Infrastructure - General overview

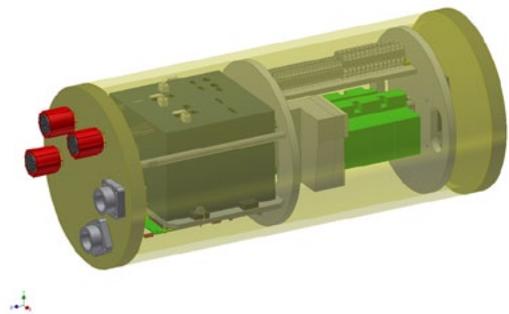


Figure 2 - Local sea bottom observatory - Node

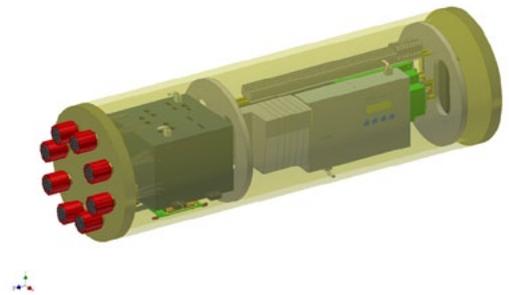


Figure 3 - Local sea bottom observatory - Junction box

HIDROBOYA: A COMPLETELY 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.

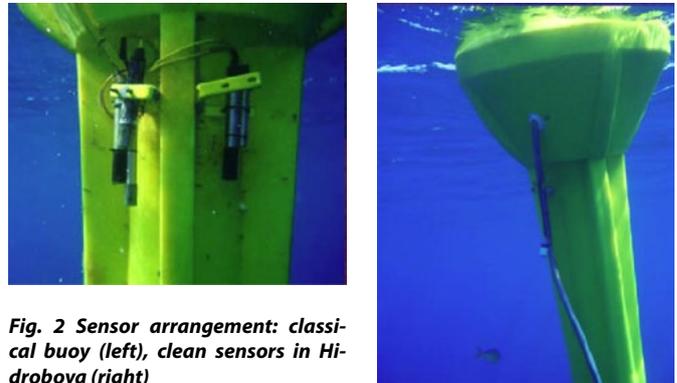


Fig. 2 Sensor arrangement: classical buoy (left), clean sensors in Hidroboya (right)



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

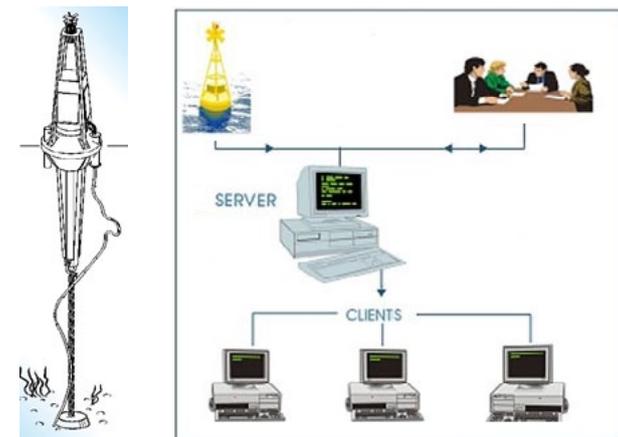


Fig 1. Buoy and "on land" system

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 or UHF 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

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 accessed 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 oce-

anic 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 from the sea or continental. Infrastructures such as [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 feed 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

ACUICOMP®: AN IN SITU COMPOSTER FOR ANIMAL BY- PRODUCTS NON SUITABLE FOR HUMAN COMSUPTION (SANDACH) GENERATED BY AQUACULTURE

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Aquaculture manufacturing, as any other production activity, generates by-products which are potentially exploitable. A good example constitutes the huge amount of fish that is usually discarded due to different causes and transformed into a new aquaculture animal by-products (AAB, "Animal by-products not intended for human consumption") that must be properly managed. Nevertheless, AAB can become a valuable material by applying the suitable technology. An alternative way to manage and value this type of waste has been developed through an in situ composting technique. Moreover, the obtained compost can be successfully used as a fertilizer or as a substrate material, and also presents several characteristics that allow its application in ecological agriculture. The device that has been designed and presented here represents a technological innovation for a sector of a marked strategic interest. In addition, it can be implemented by aquaculture farmers to add value to this by-product. In order to build up the process of in situ composting, the design, making and start up of a composter prototype have been performed, which was adapted to the conditions of the aquaculture installations existing in this geographical area. Likewise, owing to the unpredictable production rate of this by-product generally caused by the variable fish mortality, a compromise solution has been reached to combine the inner capacity of the composter and its acquisition cost. The following requirements have been considered to design and configure the prototype:

1. To be easily manipulated by the personal.
2. Characteristics that facilitate its mobility and transportation.
3. Low weight in relation to the volume of the by products to be composted
4. Low energy costs

5. No needs to connect to the general water system.
6. To minimize fish manipulation
7. To be able to incorporate a mixer for the processing and aeration of the generated mass.
8. To permit an effortless assembly and disassembly in order to facilitate the extraction of the fermented compost, along with its cleaning and maintenance.
9. To contain a ventilation-extraction air system that allows a proper fermentation.
10. To hold an automatic system that controls the handling of its electric elements and registers the technical parameters required, such as the temperature profile of the system.

Furthermore, the following requirements have been taken into account for the development of the process:

1. Mixing and aeration needs for the system to operate under aerobic conditions.
2. A temperature control that ensures the right cleaning of the by-product to be composted.
3. An adequate isolation of the reactor and a good control of possible unwanted vectors, such as odours, aerosols and wasting gases.

The composter, the so called Acuicomp®, has been patented by the University of Cadiz, which has promoted the development of the first prototype in collaboration with the Ctaqua foundation through a project funded by the Consejería de Economía, Innovación y Ciencia of Junta de Andalucía.



Fig.1. Acuicomp® composter

NEW LIGHTWEIGHT AUV AT THE SPANISH RESEARCH COUNCIL

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Abstract

The *Unidad de Tecnología Marina*, belonging to the Spanish Research Council (CSIC), is the main service provider to the Spanish marine research community. It manages different sea-going facilities as well as the Spanish Antarctic Base. In late 2010, two small AUV (Autonomous Underwater Vehicles) were acquired as testing beds for operational research on marine research at littoral and shallow waters and the UTM has spent several months acquiring experience and gathering some data to start developing tools and procedures for such platforms.

Keywords

AUV, marine research, coastal oceanography,

1. INTRODUCTION

Since 2005 the number of AUV dedicated to scientific research has increased dramatically, in part due to the miniaturization of the systems and the ability to produce vehicles light and cheap enough to be acquired by non-military organization. Although a major part of such vehicles are still dedicated to military operations there is a significant part of the scientific users, mostly dedicated to robotics and platform R+D, and a increasing number of users at the research community which starts to realize the benefits of these platforms.

2. MOTIVATION AND OBJECTIVES

As a service unit, UTM is continuously looking for new and improved methodologies for marine research, either shipborne or standalone, that can be added to the catalog of services, instruments and platforms currently available to the Spanish Marine research community.

As early as 2005, UTM started to look the feasibility to add AUV's as scientific platforms for deployment for small and ocean-going vessels, advantages and disadvantages were analyzed and a formal proposal for a deep vehicle was included in the UTM Strategic Plan 2010-2013 and Plan of Action.

Such vehicles are expensive and need some logistic support. Given our lack of experience on the field we proposed two separate phases of the implantation process:

- Phase I: Acquisition of a lightweight vehicle. Main targets are:
 - oGain operational experience.
 - oDevelop service-oriented protocols for scientific research.
 - oMake well known these platforms among the research community.
 - oDevelop operational and technical specifications for a future mid-sized ocean-going vehicle.
- Phase II: Acquisition of an Ocean-going vehicle. This would be done at the end of the current Strategic Plan (if budget allows) or during the next one. The main characteristics of this vehicle would be:
 - oGreater payload.
 - oModularity.
 - oExtended depth range (up to 3000 m.).
 - oExtended autonomy (more than 15 h.).
 - oDeployable from small and medium ships.

3. VEHICLES

In late 2010 UTM-CSIC procured two small AUV (man portable) to incorporate them to the serviced platforms managed by the unit. The vehicles are two Oceanserver-Iver2 vehicles set up in two different configurations (Water Quality Control and Imaging) that give them a high flexibility on its use.

Moreover, both vehicles are prepared to accept additional sensors and have a second CPU (backseat CPU and HDD) for this purpose.

The "open architecture" has been a key item on the vehicle selection because one of its future roles is the integration and development of new sensor for such vehicles.

4. CURRENT WORK.

At the present moment the UTM is involved on operational trials in two main locations.

The Olympic Rowing Channel near Barcelona has been used during the winter for training and basic sensor testing.

A full operational test survey is planned for mid-May at the Bahía dels Alfacs, Tarragona. During these 5 days we plan to fully test the capabilities of both vehicles for different tasks as horizontal and vertical profiling patterns, image and side scan sonar sampling and bathymetry using the DVL beams. The objective of this test is to get an idea of the real operational envelope of the vehicles before to present them to the Spanish scientific community as an additional research platform of the UTM-CSIC inventory for coastal, shallow water and inner water surveys.

Several R+D lines related with the vehicles themselves are being evaluated at the moment but the focus will be put on small payload integration, data management and data QC.

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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 this reason, 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 or below water near the surface. Its cabled connection with OBSEA provides a flexible infrastructure for marine observation, and it takes the advantage of the OBSEA data management and network control.

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 where 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 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. Currently, the onboard oceanographic instruments are a meteorological station, a GPS, and a video camera. Figure 2 and Fig. 3 show graphics with temperature and wind speed. Nevertheless, the system has the capacity to be connected to more instruments through an extension port. Currently, in this port an AWAC (integrated Acoustic Waves And Currents sensor) located on the seafloor has been connected to the buoy for telemetry. Figure 4 shows the AWAC ready to be installed.

The rest of the electronics are a 3G modem that provides real-time telemetry and a microcontroller for system control and monitoring. All these elements have been packed into two water tight boxes, one for the battery and the charger,

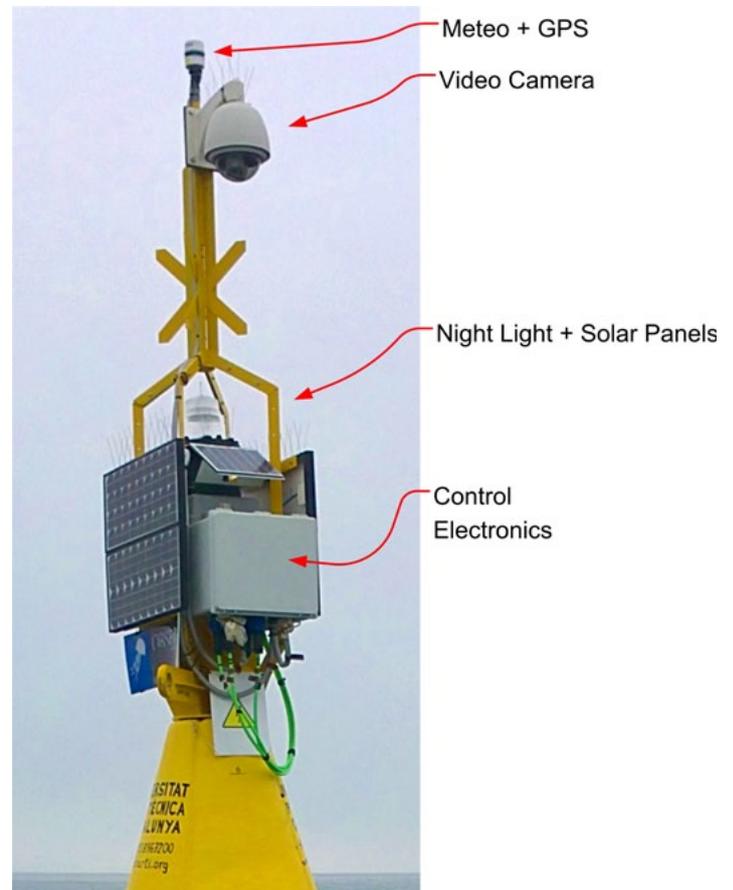


Fig. 1. Buoy and instruments

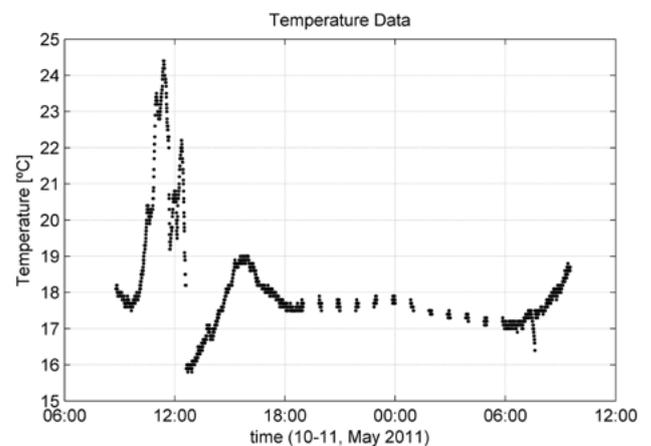


Fig. 2. Temperature

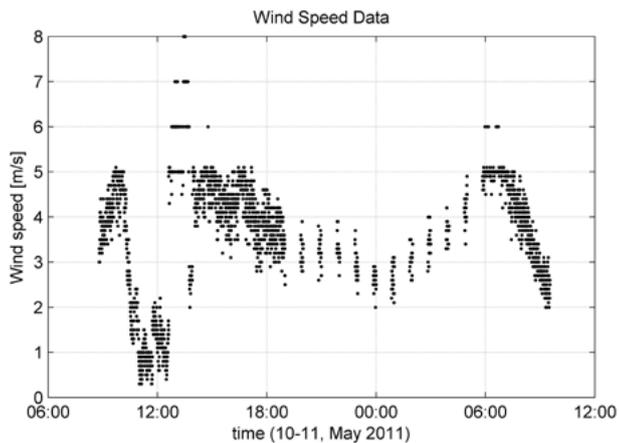


Fig. 3. Wind speed

and the second one for the 3G modem and the control unit. The video camera has its own enclosure with a transparent screen, located on the top.

III. MOORING SYSTEM

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

Figure 5 shows the simulation of the system using OrcaFlex 9.4, where 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.

IV. CONCLUSIONS

The characteristic of an oceanographic buoy has been presented, providing details of the onboard electronic 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.



Fig. 4. AWAC ready to be installed

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.

V. ACKNOWLEDGEMENTS

We want to acknowledge the financial support of the Ministerio de Ciencia y Educación of Spain, through the project "Sistemas Inalámbricos para la Extensión de Observatorios Submarinos" CTM2010-15459 (subprograma MAR).

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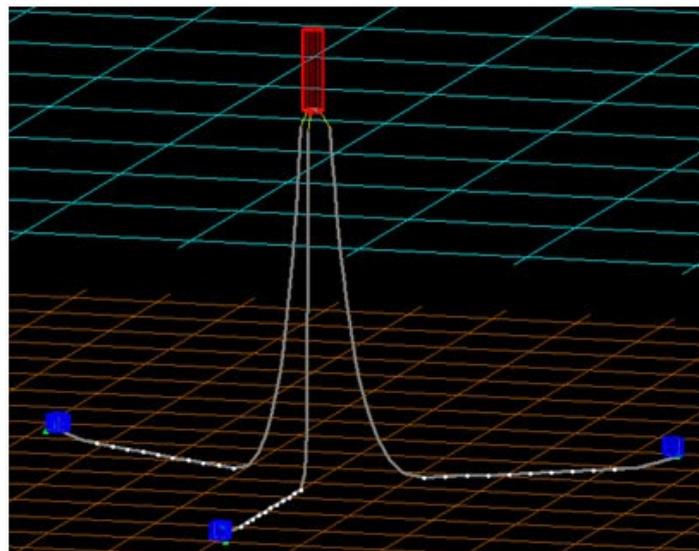


Fig. 5. Simulation of the Mooring system using three anchors.

OPTICAL PHYTOPLANKTON DISCRIMINATOR (OPD) DEVELOPED FOR A GLIDER

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Abstract.

The Optical Phytoplankton Discriminator (OPD) is an instrument that measures for the presence of algal organisms from their optical absorbance characteristics. This instrument is composed by an electronic system and chemical reagents, accomplished by pumping a water sample through a Liquid Waveguide Capillary Cell (LWCC), illuminating it with a light source, and measuring the resulting light absorption spectra. This system has been designed for being coupled to a Slocum Glider. A validation and calibration have been done, results from OPD sensor has been compared with reference material and known samples.

This sensor, the Optical Phytoplankton Discriminator (also called BreveBuster) has been used for the detection of *Karenia Brevis*, a toxic dinoflagellate which produce red tides [1].

Red tides are produced by harmful algal blooms, and they cause important losses in fisheries and economy if an early detection is not properly done.

It is probed that this sensor lets the detection of *Karenia Brevis*, and OPD generally detects the toxic bloom before any other detection system (satellite, in situ sampling...)

This automated optical method for the detection of phytoplankton communities has been developed by Mote Marine Laboratory. It has proven successful at discriminating the toxic dinoflagellate *Karenia brevis* in natural mixed phytoplankton populations in the Gulf of Mexico.

Optical Phytoplankton Discriminators (OPD) analyze particulate absorbance spectra for similarity to phytoplankton community under study through the Similarity Index, which provides a means to quantify the spectral variability in the absorption spectra and is independent of biomass as it is derived from mean-normalized absorption spectra [2].

A multiple regression analysis has been added to the optical discrimination procedure to separate taxonomic classes of phytoplankton using a library of absorbance spectra from laboratory cultures.

Recent modes of deployment include shipboard, moorings, channel markers, piers and autonomous underwater vehicles.

Results from this array of instruments are received at the Sarasota Operations of the Coalition of Ocean Observing Laboratories (SO COOL) for analyses, visualization and dissemination. Deployment and operation of these resources over the past five years has demonstrated the utility of a HAB observatory on the central west coast of Florida. Generally OPD has been installed in different fixed platforms like buoys and moorings (low pressure model, until 30 meters). But in a newer model, it has been developed a high pressure unit (until 100 meters depth) designed for AUV, mainly used in slocum gliders [3].

OPD has been also used for the detection of other kind of phytoplankton as well as toxic dinoflagellates. For the adaptation of the sensor to the determination of different communities it is only necessary having the spectra of different cultures, which lets use them as reference signal for the system.

Having sensors which detect the kind and concentration of phytoplankton communities present in an area is an important advantage in time and resources in the study of the ecological state of a region.

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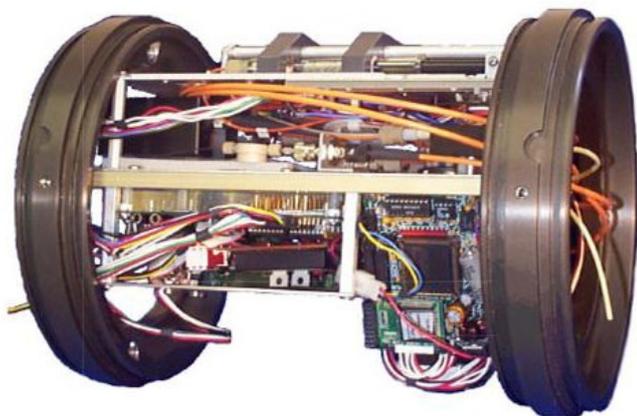


Fig. 1. The Optical Phytoplankton Discriminator (without its watertight housing).

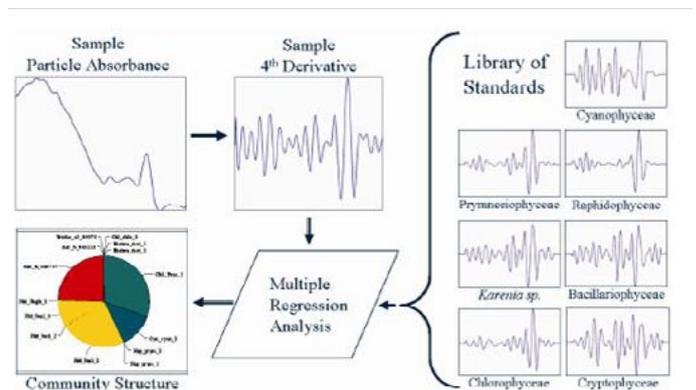


Fig 2. The multiple regression scheme for estimating phytoplankton community structure from particle absorbance spectra.

AADI IN SITU HYPOXIA MONITORING SOLUTIONS APPLIED IN THE FRAMEWORK OF THE EU FP7 PROJECT HYPOX

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More than 100 investigators from 20 different partners are involved in the EU-project HYPOX (<http://www.hypox.net/>). A prime goal of the project is to improve the understanding and prediction of oxygen depletion in aquatic systems. Extensive in-situ monitoring is done using a wide range of platforms. This presentation intends to describe some of the systems in operation in Swedish fjords including a cabled observatory with direct data delivery to the Pangaea

data base. The challenge to carry out long-term monitoring with maintained quality of oxygen and associated parameters will be discussed. Improved calibration procedures to reach better oxygen sensor accuracy and discovered artifacts at low currents will also be presented as well as results from recently developed CO2 optodes.

ENERGY FLUX IN THE GIBRALTAR STRAIT AND HOW THEY CAN BE USED AS A RENEWABLE ENERGY SOURCE

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Abstract: Within the emerging field of renewable energies, our country is pioneer in wind energy and it is relatively well placed in the solar energy ranking (both photovoltaic and csp). Other potential source of renewable energy which is virtually ignored in our country is the ocean (tidal surf) and also obtainable from the ocean currents. In this document, ocean currents as a renewable energy source in the Gibraltar Strait are studied. They must be intense, permanent and unidirectional to be profitable, therefore, we have found the places that satisfy those characteristics for installing a turbines.

Keywords: Gibraltar Strait - renewable energy - ocean currents - turbines.

INTRODUCTION.

For the extraction of energy from currents being cost-effective and technically feasible is desirable that the currents are unidirectional and intense. For example, the energy flux of a stable current and permanent of 1 ms⁻¹ (reference figure for profitability) is about 500 Wm⁻², therefore a windmill turbine blade, whose efficiency reaches values above 0,4 for three-bladed turbines (Burton et al., 2001), which are more efficient than vertical axe ones of Darrieus type (Gorban et al., 2001), it can give up to 60 kw in DC, equivalent to 0,52 Gwh per year. Today, the three-bladed turbine is the most profitable for generating electricity and it is the generator and system used in wind farms. When a turbine of this type is designed to work immersed in the sea, technical and cost reasons, it is desirable to maintain a fixed orientation, which places it at a disadvantage with their counterparts wind being oriented to face the wind and do not require therefore constant wind direction. A power plant based on the energy of ocean currents would have much higher yield, lifetime and lower maintenance costs were the more unidirectional currents.

It is not easy to find in the ocean areas that meet these two conditions, unidirectional and relatively high current intensity. Some examples are the major western boundary currents of the ocean basins (Gulf Stream, Kuroshio, Aghullas). The distance from the coast to where to locate the plant, which should be installed at the site near the core of the current, which tends to flow toward the outside of the continental shelf is typically tens of km, which would cause significant losses and high transport costs to bring the power generated to the grid. On our shores, certain areas of the Strait of Gibraltar with favorable conditions for the installation of power plants of this type and are located relatively close to shore. The Strait is a place where it has developed and continues to develop an intensive oceanographic research activity and its dynamics is fairly well understood. However, the places where the theory of the dynamics of water exchange predicts the existence of strong unidirectional currents are not fully described and missing details that are important when carrying out an engineering project aimed at extracting this kind of ocean energy. On the suitability of these

sites and its potential as a profitable source of renewable energy is the focus of this work.

METHODOLOGY

The study was carried out considering two approaches: the first one from a numerical model with which they have mapped the flow of energy. The second, experimental data from instruments moored in various campaigns conducted by the Physical Oceanography group of the University of Malaga, which are included in the project of excellence P08RNM-03 738 (FLEGER) of the Junta de Andalucía.

The hydrodynamic model used for mapping of energy is the MITgcm general circulation model developed at the Massachusetts Institute of Technology (Marshall et al. 1997). The model has a high resolution in the direction along the axis of the Strait (dx = 50 m), lower in the transverse direction (d = 200 m) while dz = 7.5 m depth in the first 300m of the column water, gradually rising to 105 m to the bottom. Data also are high-resolution bathymetry, from the digitization of the chart published by Sanz et al. 2001.

The model reproduces satisfactorily the exchange medium and the dynamics of tides in the Strait (see Sánchez-Garrido 2009), and provides outputs of the hydrodynamic, salinity and temperature every 20 minutes during a simulation that covers a period of one tropical month. This reproduces the fortnightly cycle-neap tides.

The flow maps are in sections made in areas of interest drawn in order to describe them. These sections can be transverse, longitudinal and horizontal. These maps represent the average flow of energy distributed throughout the section, an additional distinction, as the forward direction of ocean currents, positive if it is coming to the Mediterranean and negative if it is to the Atlantic. On the other hand, we have developed maps with which to have information to help determine behavioral aspects of energy flows in each zone, for example, find the points where the percentage of times the flow is above a value threshold or, alternatively, the percentage of cases in which the currents do not deviate from the mean direction.

Parallel and from data provided by the moorings is to determine reliably the spatial and temporal distribution of the intensity of ocean currents to generate energy is most favorable to the lowest possible cost.

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OPTIMAL DESIGN PARAMETERS OF AUV HULL BASED ON CFD SIMULATION

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Keyword— AUV, CFD, hull, hydrodynamics, design

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 ve-

hicle 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.

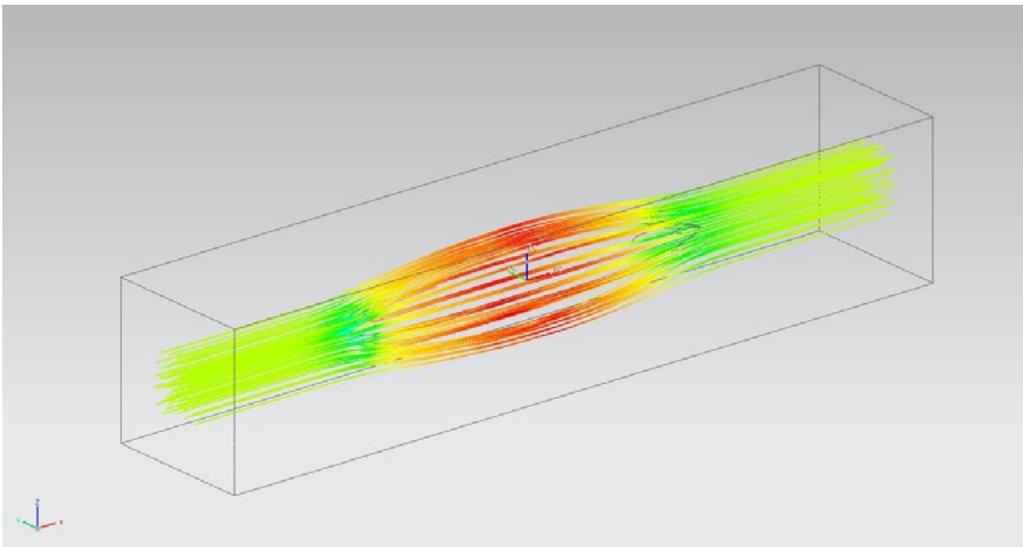


Fig.1. CFD Analysis



Fig.2. Design and Manufacturing

TIME SYNCHRONIZATION OF A COMMERCIAL SEISMOMETER THROUGH IEEE-1588

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Abstract

Seismometers use a GPS signal for time synchronization and the seismic data are collected, time marked and stored. The precision of the time marks is a key parameter for the location and magnitude of an earthquake. Land seismometers are implemented with an internal GPS receiver where only an external antenna is needed for time synchronization. This paper presents the implementation of the time synchronization of a land seismometer through the IEEE-1588 protocol. Time synchronization tests have been carried out and results are presented.

Keywords: Seismometer, acquisition system, IEEE-1588, time synchronization, time error.

I. INTRODUCTION

The IEEE-1588 "Precision Clock Synchronization Protocol for Networked Measurement and Control Systems" [1] is a new standard widely used in industrial applications as robotics, sensor networks [2] and wireless applications [3]. The objective of this standard is to specify a protocol to synchronize independent clocks running on separate nodes of a distributed measurement and control system to a high degree of accuracy and precision. The clocks communicate with each other over a communication network. In its basic form, this protocol is intended to be administration free. The protocol generates a master slave relationship among the clocks in the system. Within a given subnet of a network, there will be a single master clock. All clocks ultimately derive their time from a clock known as the grandmaster clock.

The IEEE-1588 has not been used in seismic applications yet. In marine applications seismic sensors are deployed at cabled seafloor observatories [4] where GPS signal cannot be reached for time synchronization, IEEE-1588 can be used. Furthermore, in caves where there is no GPS coverage, seismic sensors can access time synchronization data through the Ethernet network by using IEEE-1588.

In this paper, the time synchronization of a land seismometer has been carried out using the IEEE-1588. The precision of the seismic data time marks allows the scientists to locate the earthquake epicenter coordinates as well as its magnitude.

II. SYSTEM IMPLEMENTATION

The seismic system used is a Trillium 120PA together with a Taurus acquisition system from Nanometrics Inc. Weighing only 7.2 kg and measuring only 21 cm in diameter, Trillium 120P/PA seismometers are three-component, very broadband, low-noise seismometers suitable for both portable and fixed applications. With an extended low frequency range useful out to beyond 1000 s, ability to resolve Peterson's new low-noise model (NLNM) [5] down to a 100s period, low noise, and wide dynamic range, these observatory-class seismometers are ideal for tele-seismic, regional, and local studies.

The Taurus Portable Seismograph is a compact, self-contained digitizer and data logger that combines exceptional performance with versatility and low power consumption. The Taurus can be used either as a stand-alone time-series data logger or as a component in a data acquisition network. Taurus incorporates a three-channel 24-bit Digitizer, GPS receiver and System Clock, removable data storage, and remote communication options. Taurus is configurable locally using the colour display screen and integrated browser or remotely using any web browser over a TCP/IP connection. The GPS antenna is connected to the Taurus digitizer where an internal GPS receiver takes care of the time synchronization. For our application, the Taurus internal GPS receiver is removed and the Taurus connector pin-out is modified in order to receive the timing data externally. In order to simulate the external GPS data, The LM3S9B96 microcontroller from Texas Instruments is used. The LM3S9B96 microcontroller internally implements the IEEE-1588 by hardware. It is in charge of sending time synchronization frames as well as PPS (Pulse Per Second) signal (trigger) to the Taurus. On the other hand the microcontroller board carries out a time synchronization with a grandmaster clock, in this case a PXI-6682 card from National Instruments. Luminary board and the grandmaster clock are connected through a LAN network. The GPS data

and PPS trigger are sent from the microcontroller board to the Taurus digitizer via the serial port. Fig.1. shows a block diagram of the IEEE-1588 time synchronization system implemented.

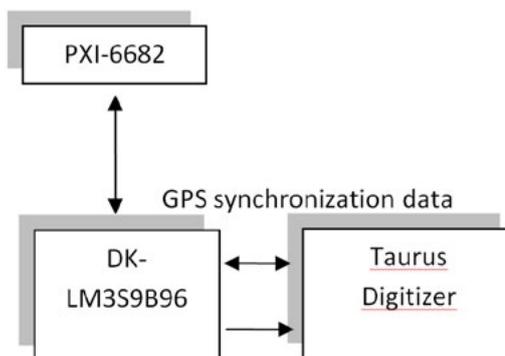


Fig. 1. IEEE-1588 time synchronization system

Software has been developed using the Code sourcery(Cprogramming) development environment and a Precision Time Protocol (PTP-V1) server. The time-synchronization flow chart is shown in Fig. 2. This software is in charge of sending the necessary timing data to the Taurus.

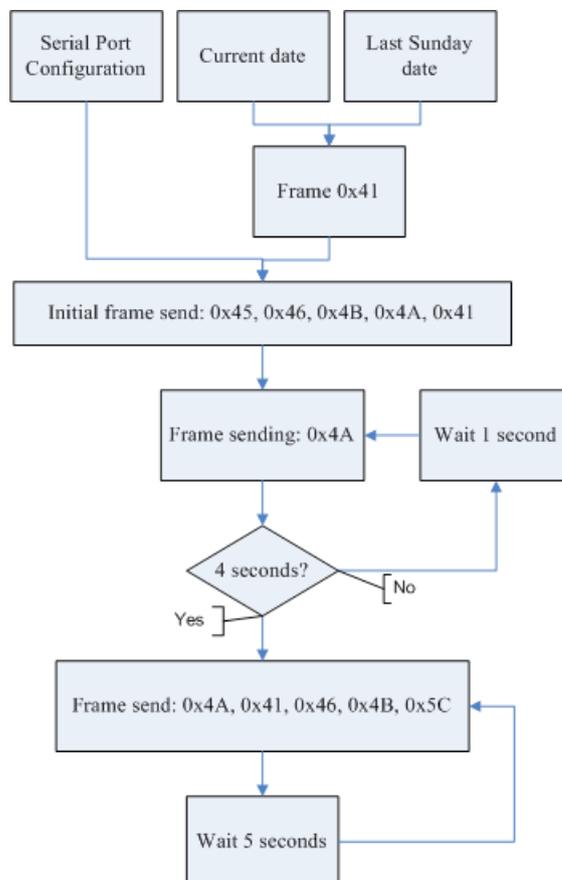


Fig. 2. Taurus time synchronization flow chart

III. TIME SYNCHRONIZATION TESTS AND RESULTS

To test the system operation, some tests have been carried out in order to calculate the IEEE-1588 time synchronization of the system implemented. In these tests we have used the synchronized PPS signal of the DK-LM3S9B96 as the input of the Taurus digitizer. A data acquisition is carried out with a 500Hz sampling rate and the stored data is studied to obtain the time synchronization error. As the synchronized PPS rising edges occur at 1s intervals, we can derive the error from the acquired data. As the sampling interval is low (2ms), it is not possible to sample the fast edges of the PPS. However, the acquired samples are interpolated and represented in a graph. Fig. 3. Shows the data acquired in this test.

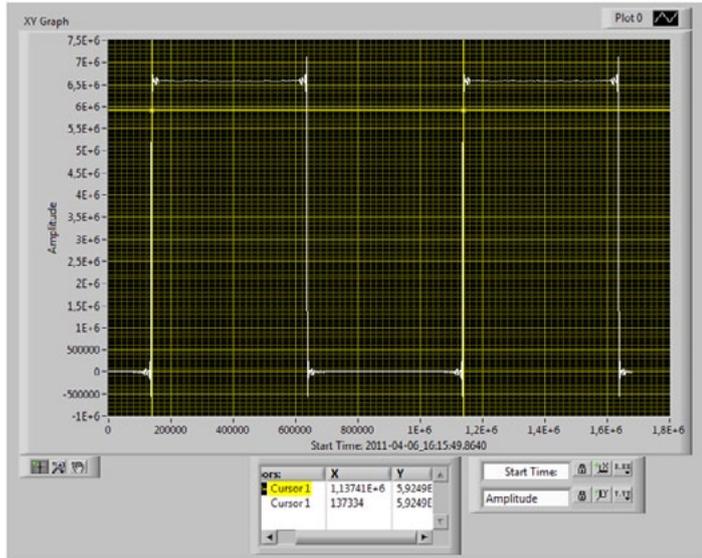


Fig. 3. Synchronized PPS signal acquired by Taurus.

In this test an error of about 76µs is observed. In order to find the delay in the acquisition, the first PPS generation time is compared to the first PPS acquired. The PPS generation time obtained from the PXI-6682 with a time resolution of a few nanoseconds. PXI-6682 indicates us that PPS generation start time is 2011-04-08_08:45:43.000000000. When this time is compared with our data retrieval, we observe that our first PPS rising edge finishes (90%) is just on 2011-04-08_08:45:43.000 (Fig. 4)

However, as the sampling interval is 2ms and the data acquired is interpolated, we can only assure that the error is below 2ms. In order to increase the time measurement resolution the PPS signal generated by the DK-LM3S9B96 is used

416	728	175	911	19
870	370	262	1284	-895
2675	-2339	3830	-2891	3343
-1024	-142	4119	-6658	11458
-13829	17207	-16729	15750	-9674
2277	10280	-23310	39642	-53482
66790	-72890	73121	-60363	35180
11433	-85275	217056	-517460	3481882
7142124	6325736	6706860	6540330	6574748
6625225	6523887	6650100	6519492	6639371
6540285	6612982	6567799	6587611	6588975
6571974	6598535	6568079	6597931	6572066
6591971	6578639	6585638	6583948	6581643
6586381	6580654	6586424	6581385	

```

StrLocChn: STN01 BHZ
Network ID: NE
Site Name: STN01
Comment:
Sensor Type:
Data Format:
Latitude: -90.0
Longitude: -180.0
Elevation: -30000
Depth:
Azimuth:
Dip:
Sensitivity:
Sens Freq:
Sens Units:
Calib Units:
Sample Rate: 500
Max Clock Drift:
Channel Flags:
Update Flag:
Start Valid Time:
End Valid Time:
Response File:
Start Time: 2011-04-08_08:45:43.0600
End Time: 2011-04-08_08:45:43.5060
    
```

Fig. 4. Data acquired by the Taurus digitizer

to trigger a burst from a signal generator. The signal generated is used as the Taurus input signal. The linear signal triggered by the PPS crosses 0V at every rising edge. This behavior can be seen in Fig. 5.

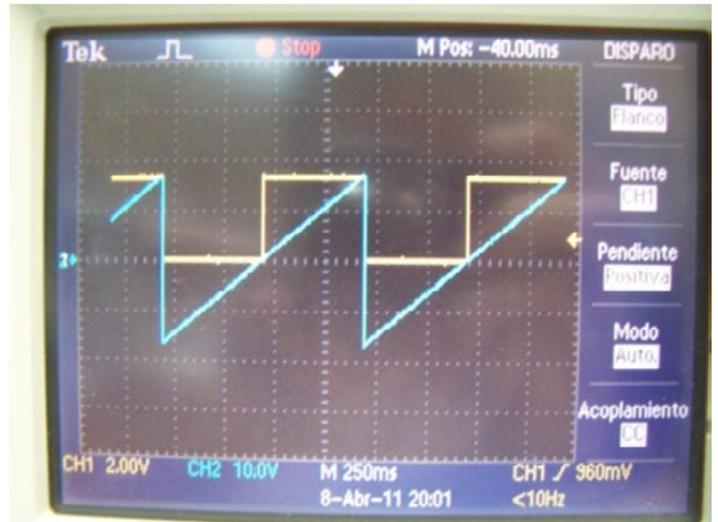


Fig. 5. Linear signal generated by a signal generator triggered by the PPS signal.

In yellow we can see the PPS trigger signal and in blue Burst signal generated by the signal generator. By decreasing the slope of the input signal at instants where the trigger signal (PPS) is generated, we can measure the time difference between zero crossings and ensure an improved error measurement. The generated signal is acquired by Taurus (Fig. 6).

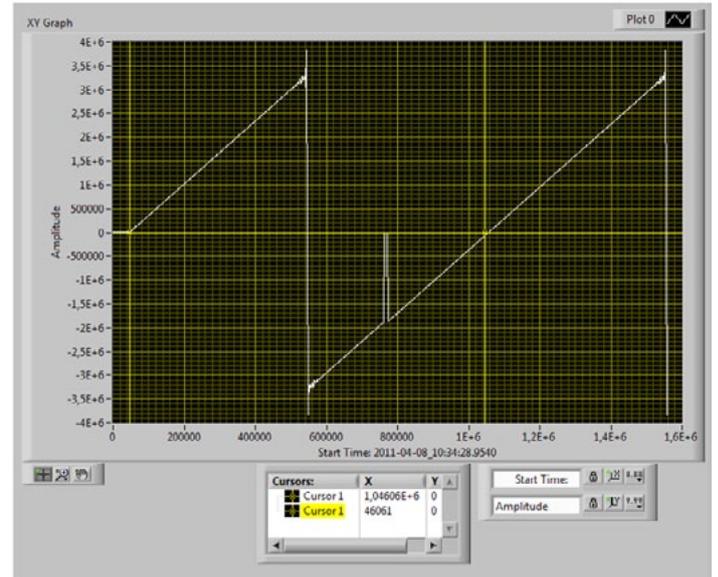


Fig. 6. Linear signal acquired by the Taurus digitizer.

We can observe an error in the second ascendant slope but it is caused by a software error when it reconstructs the signal based on ASCII data retrieval format. Fig. 6. shows that the start time of the first pulse is on 2011-04-08_10:34:29,0000061 and but it should be on 2011-04-08_10:34:29,000000000 so we have an error of 61µs.

IV. CONCLUSIONS

A time synchronization of a commercial seismometer is carried out by using the IEEE-1588 standard. This implementation is highly useful in applications where the GPS signal is not accessible. The IEEE-1588 can achieve synchronization errors below 1µs. The tests carried out show the synchronization error is about 61µs. This delay takes into account the acquisition and data processing software delay of the Taurus. In previous research, the delay between the

grandmaster clock PPS and the PPS generated by DK-LM3S9B96 was measured to be about 50ns [6]. This means that the external IEEE-1588 GPS can provide synchronization trigger error of 50ns.

ACKNOWLEDGEMENTS

This work has been carried out thanks to the projects "Cabled Digital Ocean Bottom Seismometer (OBS) – VALTEC08-1-0031" and "Deep Ocean Bottom Seismometer –PET2007_0240" funded by the Spanish ministry.

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ESTOC: NEW APPROACH WARRANTS LONG-TERM SUPPORT TO THE OCEANIC OBSERVATIONAL PROGRAM

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Abstract

The European Station for Time-series in the Ocean, Canary Islands "ESTOC" was initiated in 1994 about 100 km north of the Canary Islands in 3618 m water depth [1]. The University of Bremen, IFMK, IEO and ICCM created an Eulerian long time series on an inter- and multidisciplinary basis in order to monitor and help understand oceanic long-term variability in the North Atlantic subtropical gyre in conjunction with the Bermuda station BATS. ESTOC is an open ocean site in the sense that it is located well outside the highly variable eastern boundary with its strong coastal upwelling regime (although interaction with this regime exists), is deep enough to encompass the eastern subtropical North Atlantic's major water masses including the North Atlantic Deep Water (however not the AABW), is windward of the Canary Islands to avoid wake effects of both the major currents and winds (Canary Current and Northeast Trade Winds), and is far enough from coasts and islands (the Selvages 100 km northwards are very small and flat) to serve as reference for satellite images and altimetry. Thus, it was expected that long-term observations at ESTOC represent open-ocean eastern subtropical North Atlantic conditions and variability. The observation program was constituted by a monthly sampling program and some diverse arrays of physical and biogeochemical sensors [2].

The original aims of ESTOC were extended through the ANIMATE (Atlantic Network of Interdisciplinary Moorings and Time-series for Europe and MERSEA (Marine Environment and Security for the European Area) project framework. Among the principal aims we can emphasize the development of a European carbon cycle time-series infrastructure at 3 key sites in the north east Atlantic. Those sites were networked within a larger-scale ocean carbon observing system, providing critical input to studies on climate change and in particular the role of carbon dioxide (CO₂). European integration was also recently achieved with nine European deep-ocean stations through the EuroSITES project (European Ocean Observatory Network).

ESTOC has the widest time-series data of hydrography and biochemical measurements from the ship-based casts carried out in the Northeastern Atlantic Ocean (from 1994 to date). In addition, the historical ESTOC marine observational programs provide with supplementary time-series of high resolution data from moored sensors such as current meter, sediment trap, temperature, salinity and nutrient meters. Recently, the pH, CO₂ and dissolved oxygen sensors were added to the ODAS buoy, with real-time data transmission.

The ocean/atmosphere CO₂ fluxes and its influence on the biogeochemical

processes is currently the main research focus [3-5]. Warming and changes in circulation and biology most likely will indeed lead to a further CO₂ increase, depletion of dissolved oxygen and ocean acidification, thus justifying the need for continuous and long-term operation of the station.

In order to warrant continuous and long-term operation, ESTOC is now operated by the Canary Islands Oceanic Platform "PLOCAN" Observatory, thus securing operation and maintenance until at least 2021. PLOCAN provides three gliders ready to operate around the site. The combination of the ship-based sampling, moorings, glider flights, ARGO profilers and drifters, as well as the historical time-series data, makes the ESTOC site an observational oceanic reference in the North Atlantic. In addition, PLOCAN Observatory is associated to ESONET and an accepted site infrastructure for EMSO. All Observatory components are open to science and R&D projects with third parties, including sensor connection and testing.

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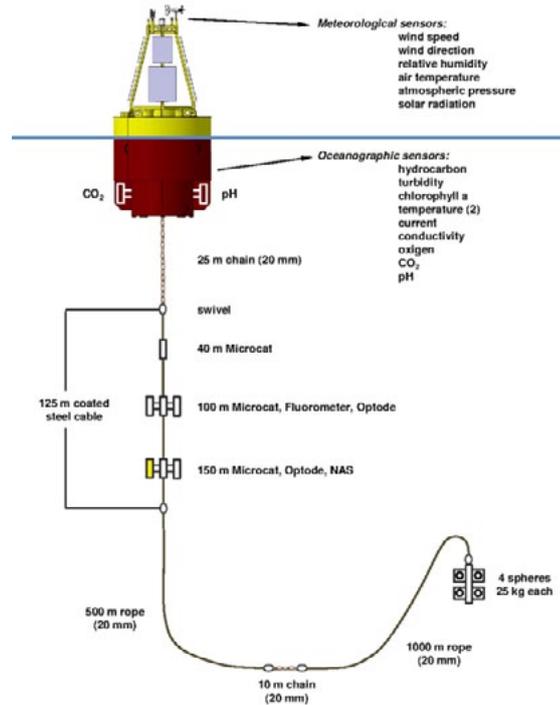
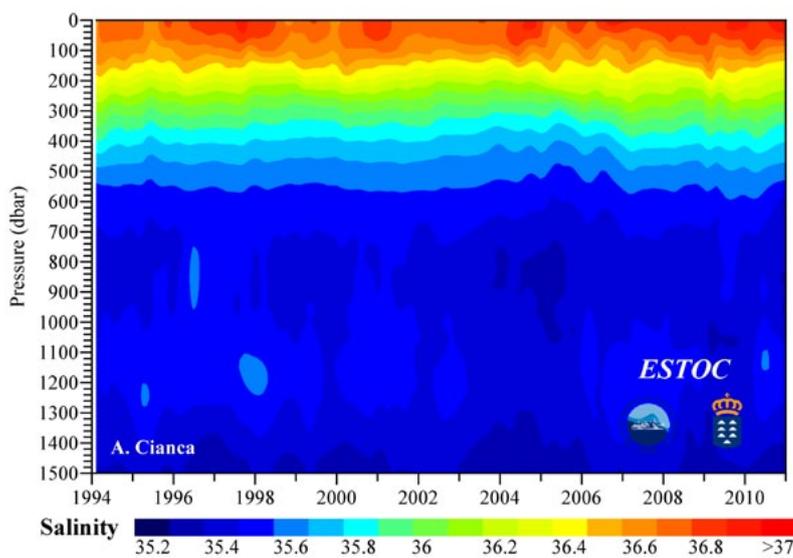
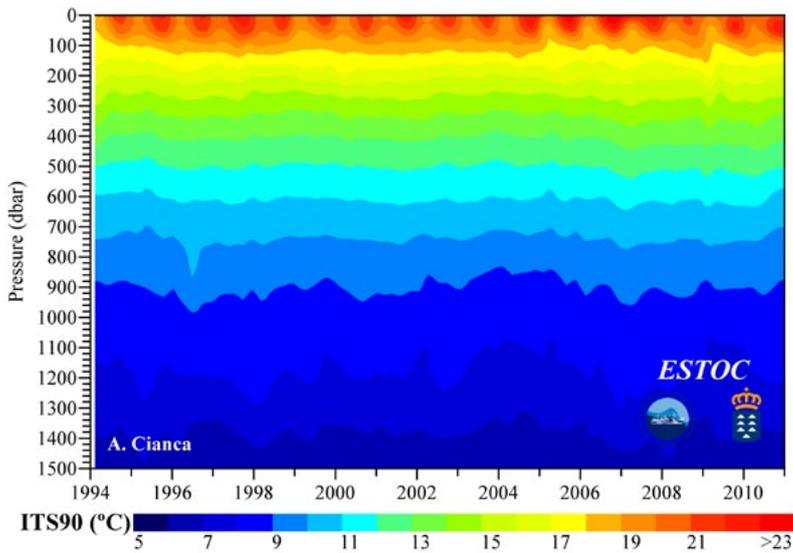
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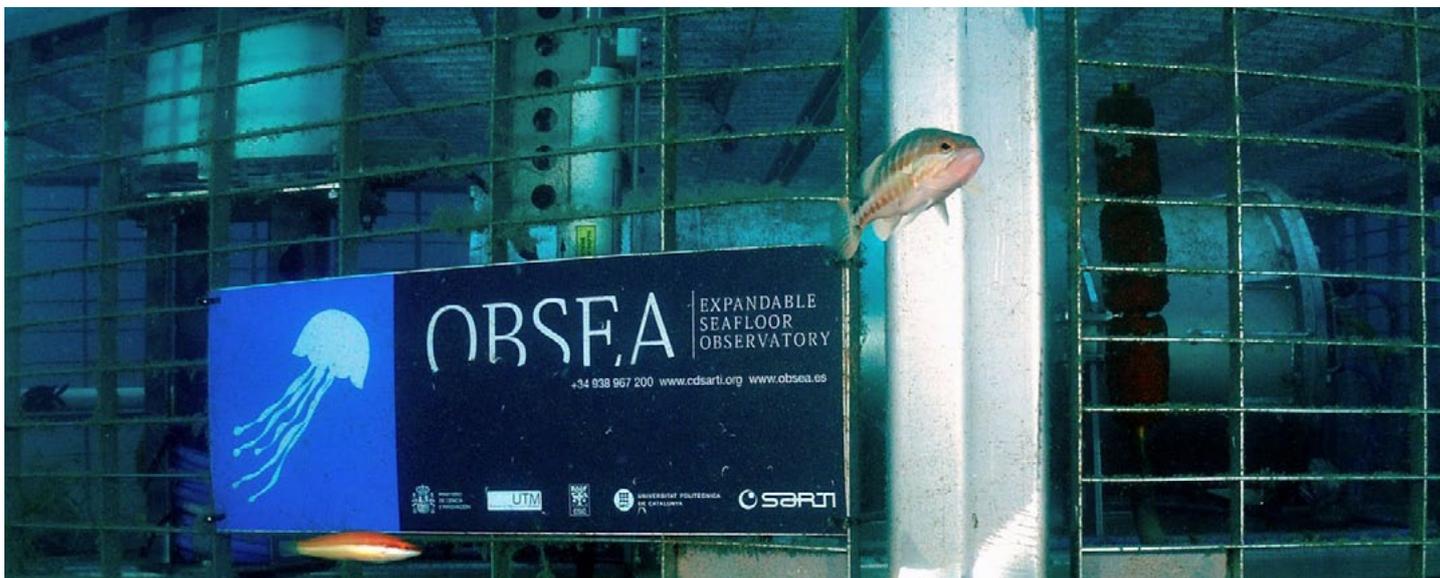
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(above) Fig. 2 Current state of ESTOC Mooring

(left) Fig. 1. Temperature (top) and salinity (down) time-series at ESTOC site, from surface to about 1500 meter depth..



OBSEA detail. Picture by Ramon Margalef.

SYSTEM CALCULATION OF VOLUMES BY IMAGE ANALYSIS ON SHARKS

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Abstract – Determining the volume of an animal can help us to understand certain aspects of its hydrodynamics and thermodynamics, such as behavioral thermoregulation and energy consumption. This determination is difficult due to the irregular shapes of the animal's body. On the other hand, large calibrated tanks are needed for measurements and this is not functional.

We have designed an innovative mechanism to register morphological characteristics in a fast, low-cost way, using standard digital photography.

Keywords – measure morphological data, photography, mesh, low-cost, volume, shark

I. INTRODUCTION

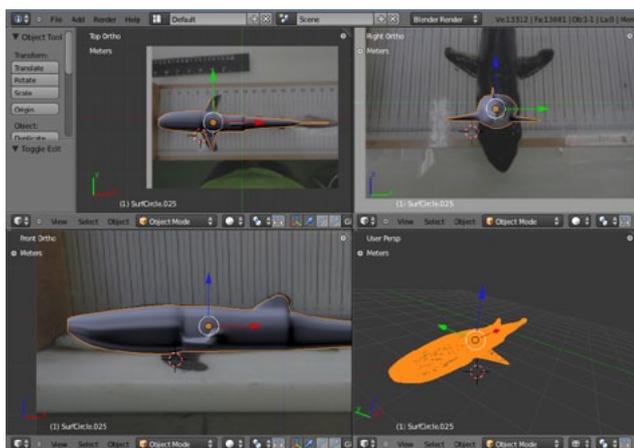
Pelagic sharks play a vital role in maintaining the balance of marine ecosystems. They have been under increasingly intense fishing pressure due to a higher demand for shark products. This over-exploitation affects populations that are generally fragile and is leading some species to the brink of extinction. In this context, more investigation is necessary to know those animals.

Determining the volume of an animal helps us to understand aspects of its hydrodynamics and thermodynamics, such as behavioral thermoregulation and energy consumption. Calculating the volume of animals is complicated because they have irregular shapes of the bodies. On the other hand, large calibrated tanks are needed for measurements and this is not functional.

In this work we present an innovative system to calculate volumes by image analysis. In a first step, we need to create a mesh in 3 dimensions from two photographs of 2 dimensions. In a second step, a program determines the volume analyzing the figure. It is important that the mesh is well adapted to the body. This system could be used for the automatic counting and monitoring of other species in the environment.

II. OBJETIVES

1. Finding a way to accurately measure the volume of large sharks. This method should be able to be used in ships.
2. Quantifying the error to create a 3D model through 2 photos.
3. Implementing the process for measuring volumes in other species.



III. EXPERIMENTAL CHARACTERIZATION

We worked with the blue shark (*Prionace glauca*). Preliminary tests had helped us to set the range of measures that we were bound to work with, from 0.5 to 15 l.

We conducted experiments with small sharks. These sharks' volume was calculated accurately as they could be introduced in test tubes. Indeed, the only way

to accurately measure volume is through volume displacement techniques, using a big test tube (2 meters high and 400mm in diameter), specifically designed for the test.

In a second step we set the characteristics of the photos that we would use for the estimation of the volume: zenital position, and lateral position.

Finally, we took zenital and lateral pictures of the shark against a background scale. This enabled us to establish common axes. In the computer, the photos are transferred to the Blender program, an open source 3D graphics application that can be used for modeling and creating interactive 3D applications. It creates a 3D NURBS mesh and converts it into a triangulated mesh to calculate the volume.

This calculation is performed by AdMesh software (program for processing triangulated solid meshes in STL file format) that checks the integrity of the mesh and closes the holes. The software gives the result of the volume by finite elements. This result is compared with the one obtained in the test tube.

IV. PRELIMINAR RESULTS

The first 3D models had an error of 24% approximately. As we made new measurements with larger animals and obtained new meshes the error decreased to under 10%.

	Tiny Shark	Medium Shark	Large Shark
Real Measure	0,185	1,98	10,95

Mesh 3d	With fins	Without fins	With fins	With-out fins	With fins	With-out fins
	0,230	0,195	2,28	2,15	13,3	11,9
Error	24,3%	5,4%	15,1%	8,6%	51,4%	8,6%

An interesting observation is that taking into account the shark fins on the 3D model increased the final error by a constant value. On the other hand, the mesh is easily adaptable to a spindle-shaped smooth profile, but does register nooks and crevices of a real animal (mouth, holes). We believe that both errors compensate each other.

V. CONCLUSIONS

The volume measurement of large sharks is not easy to perform accurately, and less on board of a ship. The proposed model is the indirect calculation through photographs and finite approximations through a digital model of the shark. This process gives us a 10% error in the calculation, which is better than the one done in the field.

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BUOYANCY CONTROL SYSTEM THROUGH INJECTION OF WATER INTO A PRESSURE TANK

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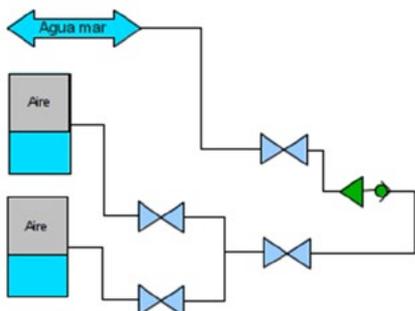
Abstract - The purpose of this report is to present the design and operation of a buoyancy control system for an autonomous underwater vehicle (AUV) that enables rapid construction, high reliability and low cost.

Keywords - AUV, bouyancy system, low cost

I. INTRODUCTION

All ships and submarines on the surface, are in a state of positive buoyancy, weighing less than the equivalent volume of water displaced (according to Archimedes' principle). To submerge hydrostatically (without mechanical assistance), a ship must gain neutral buoyancy (weight equal to water drive) by increasing its own weight or decreasing the water displacement (volume). To control their weight, submarines are equipped with ballast tanks that can be filled with water or air taken from outside.

This system is designed for a vehicle (project VACCA) that will operate in coastal regions, and thus must consider the important density variations found in those regions, resulting, for instance, from upwelling processes or river discharge. This density can vary in the surface from 995.6 kgm⁻³ for the case of fresh water at 30 degrees to 1028.7 kgm⁻³ with a salinity of 37 and a temperature of 9 degrees. It should consider that the density can reach 1030 kgm⁻³ in the event that the unit is used for example in Mediterranean waters.



Moreover, the value of density is not constant with depth. The density may be constant in a certain range of depths (mixed layers) and then change abruptly in just a few meters (pycnocline). The device, when profiling should be able to adapt to the changing buoyancy conditions.

On the other hand horizontal variations in the density of water, caused in turn by variations of temperature and salinity, lead to the so-called thermohaline currents. The intensity of these currents is usually very low (about 0.2 knots) but occasionally can reach 1 knot near the coast.

II. SYSTEM DESCRIPTION

The system has three main components of a pressurized tank, a pump and valve system. The system volume can vary by adding or subtracting water. When empty, the tank provides a positive buoyancy and negative buoyancy when the tank is full. The system is controlled by the level of water in the tank. This system is the most flexible of the methods to control the buoyancy of an AUV.

The simplest design is that the tank is at atmospheric pressure and buoyancy of the vehicle diminishes as the water fills the tank. To increase buoyancy, the water is pumped out. In this scenario, the tank has to be sturdy enough to withstand hydrostatic pressure when empty (pressure differential).

You can pre-pressurize the tank thus reducing the pressure differential between the tank and the water. In this case, the preload would reduce the energy consumed in the pump, but would require a more complicated system of valves.

The major advantage of this design is the scalability and utilization of space. This

advantage derives from the unique dependence on a single tank for buoyancy control. It is only necessary to find components that meet the required specifications for the operating pressure.

The improvement in performance only requires a larger deposit, since the pump can always work at maximum design power.

It is not possible to fill the tank completely, there will always be air in the tank. The maximum available volume of the tank will be 85-89%.

III: CONCLUSION

It is important to note that the choice of flotation systems relies heavily on the use of the vehicle. In our case, the AUV must make multiple vertical profiles over 24 hours. Hence, we think that a buoyancy control system through water injection is the best way to save energy.

But the main reason for developing a buoyancy control system is the possibility of using this system (or foreground) in future applications of AUV, such as horizontal navigation, maintenance at a certain depth, tilt control, etc.



ACTIVITIES PERFORMED AT THE MARINE TECHNOLOGIES UNIT (CETMAR)

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Abstract- This contribution describes the origin and activities of the Marine Technologies Unit (UTMAR), part of Centro Tecnológico del Mar, Fundación CETMAR. The Unit focuses on the development of capacities and initiatives in the field of marine technology, as well as the provision of highly qualified services through the oceanographic calibration laboratory and workshop for oceanographic equipment.

Keywords: Marine technology, Technology transfer, Calibration, CTD profilers, Oceanographic buoys

BACKGROUND

The "Centro Tecnológico del Mar-Fundación CETMAR" was funded in 2001 on the initiative of the Xunta de Galicia and the Ministerio de Ciencia e Innovación. Its main objective is to promote cooperation between institutions, research centres and the marine-fishing sector, identifying the needs of the productive sector and helping with the transfer of technology to meet those needs. CETMAR participates in projects and develops partnerships at regional, national and international levels, and both the public and private sectors related to the sea and its resources are beneficiaries of those activities.

The Marine Technologies Unit (UTMAR) is part of CETMAR and it was created in 2009 in a context of an increasing need of continuous monitoring of the water quality which in turn was linked to the implementation of the European Water Framework Directive (2000) and its transposition through the Spanish "Directiva marco sobre la estrategia marina" (2008). Furthermore, there was a clear support to all activities related to the development of marine instrumentation and ocean observation both from intergovernmental initiatives such as GOOS, or encouraged by the European Commission (GMES). In a regional scale, funding was located (RAIA project) to help and consolidate a cross-frontier oceanographic observatory in an area (NW coast of the Iberian Margin) where an important potential had been identified, with numerous institutions and companies working in that field. UTMAR, through its participation in RAIA project, contributes to that consolidation by providing strategic services: an oceanographic laboratory for the calibration of CTD sensors and a workshop for oceanographic buoys.

THE OCEANOGRAPHIC CALIBRATION LABORATORY

The Oceanographic Calibration Laboratory (Fig.1) is equipped with the best

available technology and designed to comply with all the requirements of the current international quality standards. It is endowed with primary physical standards, secondary transfer standards and specific equipment to perform temperature, salinity and pressure calibrations. The choice of instrumentation in the absence of an international standard or any other official methodology was a complex process. Throughout this process, the highest quality standards for testing and calibration laboratories (ISO 9001 and ISO/IEC 17025) were considered.

Finally, the instruments selected were the following:

Temperature

- SPRT probes.
- Temperature-fixed points (TPW and Gallium melting point).
- High-capacity temperature-controlled bath.

Salinity

- GuildLine Autosal.

Pressure

- Hydraulic Death Weight Tester for high-pressure ranges.
- Pneumatic Death Weight Tester for low-pressure ranges.

Ensuring high-quality marine data is an actual need not only for the observatory but for all the institutions and companies involved in marine observation. In this way, the Oceanographic Calibration Service was born to meet this technological gap and to provide technical support to all these potential beneficiaries of the laboratory services.

SUPPORTING RAIA OBSERVATIONAL NETWORK

In addition to the oceanographic laboratory, UTMAR is undertaking new tasks as new observational infrastructure is incorporated in the RAIA observatory. Amongst them, more capacities are being developed related with the design, equipment and installation of oceanographic buoys. Following this on-going experience, a new monitoring system is being devised to optimize the installation of oceanographic buoys and facilitate its further maintenance, thus reducing costs.

To tackle particular problems from researchers, specific technical solutions have been proposed and developed (see companion paper in this issue "System calculation of volumes by image analysis on sharks" by González and Mucientes).



Fig. 1. Temperature bath in the UTMAR-CETMAR Oceanographic Calibration Laboratory

USE OF A TRUNCATED CONICAL TANK TO IMPROVE UNDERWATER ACOUSTIC EXPERIMENTS

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Abstract – Experimentation in Underwater Acoustics field presents several difficulties derived from the environment selected (sea, ocean or lake) and its accessibility. A priori, these drawbacks can be solved in closed test environments such as cylindrical and parallelepipedical shaped tanks typically used by scientific community. However, in these scenarios, diverse physical phenomena provoke the signal perturbation. In this paper, these crucial problems are analyzed and it is presented the advantages of using a truncated conical tank in Underwater Acoustics research.

Keywords – underwater acoustics, reflection, multipath, tests tank, truncated conical tank

INTRODUCTION

Underwater Acoustics is a scientific field which deals with the study of underwater sound propagation of physical signals, involving the generation, transmission and reception of acoustics waves. In particular, Underwater Acoustics analyzes how the medium variability has an influence on signal communications. For instance, the depth, temperature or salinity leads to changes at the sound velocity of the waves transmitted. Furthermore, several physical phenomena such as reflections, scattering, reverberation, absorption or Doppler effect can affect significantly to the signal propagation. It can be also disturbed by different sources of noise. All those phenomena result in a decrease of the wave strength, and many occasions, the signal loss. Therefore, it is an important issue to consider, which is studied in this paper.

TRADITIONAL UNDERWATER ACOUSTICS EXPERIMENTATION

In order to test underwater devices and take acoustics measurements, an appropriate test scenario is required. A first option is to deploy an acoustic source and a receiver in the sea. However, research in this environment or in other real scenarios such as oceans or lakes may result highly difficult and expensive. Sea tests require renting specialized infrastructures like a ship, and so, there is a need of planning the experiment with enough beforehand. Furthermore, the weather is another important requirement to take into account in an outdoor deployment. Bad atmospheric conditions would involve high costs and delays.

This leads us to notice the advantages of using an accessible and controlled tests environment [1][2]. A tank solves these aforementioned shortcomings, providing an efficient test-bed environment for signal probes. However, the usage of a simple hydroacoustic tank with a parallelepipedic or cylindrical shape involves new drawbacks. In particular, in these closed environments, the most significant physical phenomenon is the signal reflection which has adverse influence on transmission, being even more relevant than the produced one into a sea environment. Usually, in the sea, the reflection appears when the waves bounce in the surface or the bottom. In a tank, the increase of signal reflections

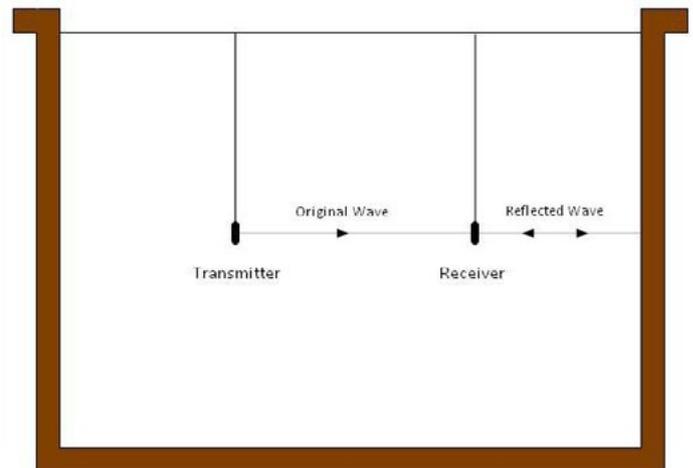


Fig. 1. Typical controlled environment.

is considerable due to additional bounces in the walls of the tank (Fig 1). Therefore, when a source device transmits a signal, the waves generated will arrive to the sink with different phases (this phenomenon is denoted as multipath). In this case, if the delay between the direct wave and reflected ones is short, the sink receives a mix signal formed by direct and reflected waves, not being able to distinguish them. These interferences and fading phenomena provoke that the sink does not comprehend the information received. To avoid these drawbacks, we should work with a special shaped tank, where the experiment can be controlled and also the process is quite similar to the one in the sea, decreasing the number and strength of the waves reflected.

HOW TO SOLVE THE AFOREMENTIONED PROBLEMS: TRUNCATED CONICAL TANK

The way to work in a controlled environment and avoid extra reflections derived from the presence of physical boundaries is solved by using a tests tank with a special geometry. The best solution known so far is a truncated conical tank (Fig.2). The leaning walls deflect reflected waves upward avoiding them to get the sink.

In this sense, the tank at Technological Naval Center in Murcia, Spain is the only tank in the entire country with this advantageous shape. With 10 meters depth and 20 meters diameter, its truncated conical shape comprises the best scenario for developing underwater acoustic tests. The layout with the transducers in the tank can be seen in Fig.2.

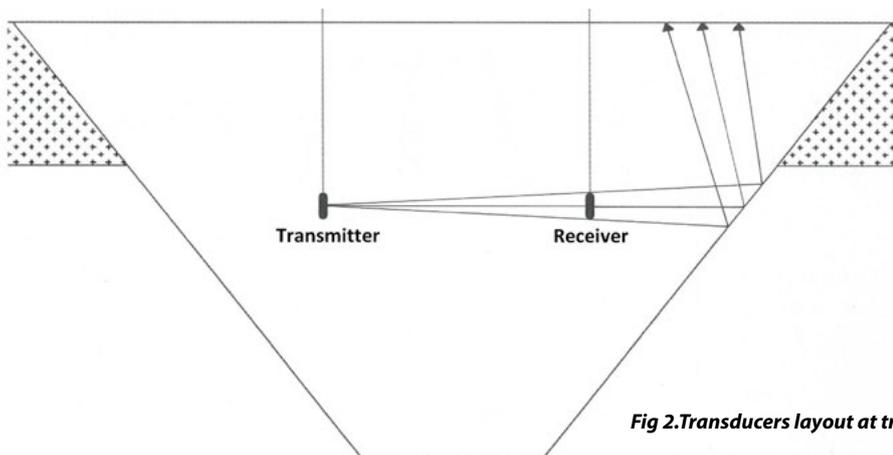


Fig 2. Transducers layout at truncated conical tank.

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SURFACE CURRENTS IN THE MACARONESIAN REGION, THIRTEEN YEARS OF DRIFTING DATA.

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Abstract- More than 500 drifting buoys were deployed during the period of 1998 – 2010 in the Macaronesian region. The study of their trajectories has provided a good knowledge about the surface current system in this area. All this information has been implemented into a model intended to cover marine emergency situations in the Macaronesian archipelagos, such as search and rescue operations and pollutant dispersal. The aim is to develop an Operational System, based in the combination of observations and analyses of oceanographic data with numerical simulation, in order to predict the drifting objects trajectories.

Keywords: drifters, surface current, model, Operational System

INTRODUCTION

This development took place under the Surface Velocity Program (SVP) of the Tropical Ocean Global Atmosphere (TOGA) experiment and the World Ocean Circulation Experiment (WOCE). Initial funding was provided by the US Office of Naval Research, with subsequent support from NOAA and the National Science Foundation. Competing designs were submitted by NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML), MIT's Draper Laboratory, and Scripps Institution of Oceanography (SIO).

Currently all the data collected with these buoys are being processed to establish the patterns of subsurface currents, studying their seasonality and variability in the environment of the Macaronesian archipelagos (Canaries, Madeira, Azores and Cape Verde), this took place under the MacSIMAR Projects (Incorporation of the Integrated Meteorological and Oceanographic Monitoring System in the Macaronesia, within the strategy of the integrated European marine/ maritime research). These data can be integrated into predictive models of drifting objects, in order to provide assessment in the possible events of human or material loss due to maritime accidents.

In the eastern Atlantic, the circulatory flow of the subtropical gyres recirculates a considerable amount of waters that enters this eastern basin across the central Atlantic ridge, mostly to the south and, to a lesser extent, to the north of the Azores. The main transport is concentrated in the Azores current and continues towards the east following the zonal currents of the Azores Front, where the anticyclonic flow turns and branches into three currents in the Canary Basin. The first branch flows very close to the eastern flank of the central Atlantic ridge; the second is located in the central Canary Basin; and the third circulates around Madeira and constitutes the Canary Current.

DRIFTING BUOY

Since the 1970s, many drifting buoys have been deployed as part of a wide range of scientific studies. This drifter consists of a surface buoy and a subsurface drogue (sea anchor), attached by a long, thin tether. The buoy measures temperature and other properties, and has a transmitter to send the data to passing satellites. The drogue dominates the total area of the instrument and is centered at a depth of 15 meters beneath the sea surface. Each drifting buoy can be fitted with a range of sensors to measure the surface temperature of the sea, barometric pressure, salinity, wind speed and direction, etc. The buoy also carries sensors testing for submersion and tension on the tether, to prove that the drogue is still attached. Drifter locations are estimated from Argos, a satellite-based system for collecting, processing and distributing data, which is operated by Collecte Localisation Satellites in Toulouse, France.

The Drifter Data Assembly Centre run by NOAA/AOML is based in Miami, Florida. The mission of the centre is to collect the data, verify their quality, interpolate them at six hours intervals and keep them in the database which can then be consulted online. The database currently contains the data from 13,876 SVP drifting buoys deployed since 1979. The data collected from this array of buoys comes from many countries participating in the Global Drifting program.

RESULTS

The results of the annual surface circulation in the Macaronesian archipelagos obtained from drifting buoys have provided a good knowledge of the surface current system in this area. It also confirms the variability in current direction as

an indicator of the tendency for gyres to appear in the current. This information has allowed us to compare the structures observed from satellites with drifting buoys deployed in the area.

An Operational Oceanography System is being implemented, based in the combination of observations and analyses of oceanographic data with numerical simulation, in order to try predicting the drifting object trajectories. It is intended to cover marine emergency situations in the Canaries Archipelago waters, like research and rescue operation. The buoys trajectories are used for the calibration of the results obtained by the models. The development of the model is by means of the hydrodynamic equation and the most probable trajectory is obtained for the initial conditions.

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Fig1. The trajectories of a buoy deployed in Azores



Fig2. The trajectories of a buoy deployed in Canaries

AMASS AUTONOMOUS MARITIME SURVEILLANCE SYSTEM

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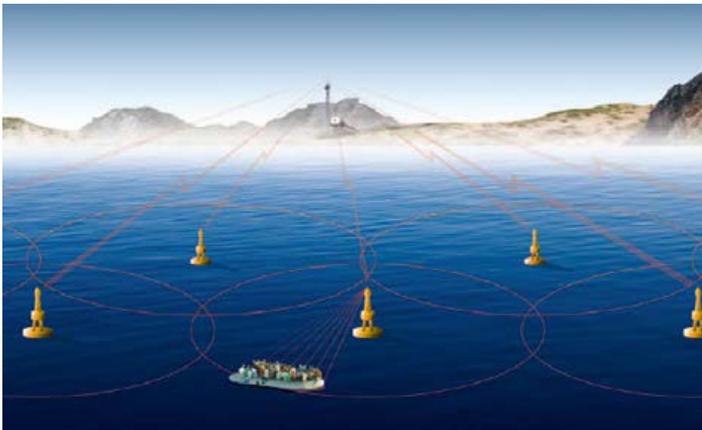
Illegal immigration by sea has become a major headache in recent years. In fact, EU member states detected more than 48,000 cases in 2007 alone (source: Frontex annual report). It is difficult to monitor – and is dangerous, often ending in tragedy. Other criminal activities, such as drug smuggling and terrorism, are also harder to police at sea. In short, controlling blue borders is a complex and costly challenge. Until now, border agencies have relied on ships, planes or helicopters to patrol and protect coastlines. But this approach is not completely reliable – and is a drain on vital resources such as money and manpower. That's why the EU is seeking a more effective response to the challenge.

Now, Carl Zeiss Optronics is leading the development of a new, groundbreaking solution for monitoring maritime borders: AMASS – the Autonomous Maritime Surveillance System. Commissioned in 2008, the initiative is partially funded by the EU, and has seen Carl Zeiss team up with nine technology specialists and border agencies from across Europe – including Instituto Canario de Ciencias Marinas (ICCM) from the Canarian government and the Armed Forces of Malta (AFM) as a final users of the system.

In a trailblazing project, the EU-backed consortium is creating an innovative system to enable the early detection and location of small and midsize vessels. The aim? To provide authorities with early warning of illegal activities at sea and improve overall protection of European shores.

The AMASS system comprises a network of unmanned platforms (moored buoys) located a considerable distance from shore. Each autonomous platform is fitted with cutting-edge sensors (optical and acoustic modules) and operates self-sufficiently (power system based on solar, wind and fuel-cells), i.e. without the need for manual intervention. Data captured by the sensors is transmitted to a central command centre, where an operator views it on screen. If a suspicious entity is detected, a crew can be dispatched to investigate or other action taken.

The leading-edge technology behind AMASS provides reliable, 24/7 surveillance – giving border agencies the early, accurate warnings they need. The optical sensors offer a 360-degree view of the area above water – significantly improving situational awareness for coast patrols. What's more, the platforms remain fully functional in all weather conditions. AMASS is also significantly more economical to operate than patrol ships, and frees up human resources for other tasks – providing an all-round more cost-efficient solution. But most importantly, AMASS helps border agencies protect their own personnel and save the lives of immigrants. The upshot? Safer, more secure European coastlines.



WELCOME PROJECT: TOWARDS A NEW WAVE ENERGY CONVERTER TECHNOLOGY CONCEPT

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The Spanish Ministry for Science and Innovation (MICINN), through its 2008-2011 R&D&I Plan and the Subprogramme for Strategic Projects in Energy, (following protocols included in the E-Plan), has granted 2.1ME for the development of an innovative wave-power generator, based on the multiple uptake of potential and kinetic energies from sea waves, under the name of WELCOME Project (Wave Energy Lift Converter Multiple España). Led by PIPO SYSTEMS (www.piposystems.com), the project is also developed by a Spanish consortium composed of the company ANORTEC (www.anortec.com) and two public research institutions: Plataforma Oceanica de Canarias (PLOCAN) (www.plocan.eu) and Consorcio Escuela Industrial Barcelona (CEIB) www.ceib.upc.edu.

The proposed system is based on the APC-PISYS technology (first state-of-the-art device designed with multiple collectors and complementary converters, able to transform off-shore wave-power into useful energy), providing clear technical and economic advantages over its single-use competitors. Singularities of this device hinder a direct comparison. However, based on previous studies and validations performed, it is expected that under similar swell conditions, a multiple system as the one proposed, will double-up both the power and energy generation of the best single-use technologies. The 1:5 scale prototype, operated in typical Canary Island's mean-swell conditions, is expected to generate powers between 100 and 120 Kw/h.

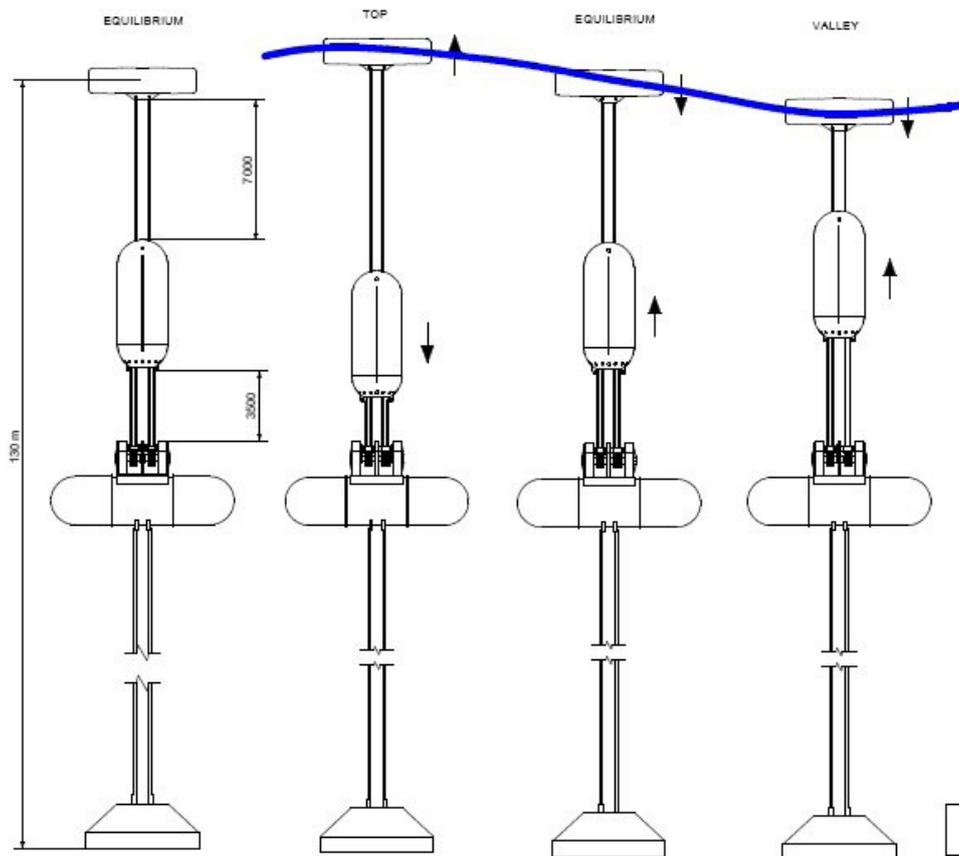
APC-PISYS is a wave energy converter, designed by PIPO Systems divided into the following main parts: Surface buoys, Buoy of variable volume, Positioning

buoy, Mechanical transmission system and Anchorage and mooring systems. Two sections are operated (Surface buoy - Yellow / Submerged buoy of variable volume - Red). Both buoys are joined by hawsers that are tautened by buoyancy forces from a windlass. Using this windlass the linear movements are converted into rotational movements, which finally are converted in one direction only.

The buoys always move in opposite directions, simultaneously increasing their strength and the distance travelled. The third buoy (green) keeps a constant depth by means of its mooring on the seabed. In this positioning buoy the systems for control, generation and measurement of the power are enclosed. The oceanographic measurement systems are situated a chamber in the interior of the superficial buoy and have specific external supports.

WELCOME's main aim is to develop and demonstrate usefulness, as well to apply the APC-PISYS technology capacities to the well-know and widespread existing energy shortage in marine monitoring autonomous devices for both coastal and off-shore applications.

Prototype's design and construction have been carried out in Barcelona and Gran Canaria (Canary Islands), expected to be ready for mooring and put into operation in summer 2011 on the NE coast of Gran Canaria, giving support to a complex oceanographic buoy as application-example for remote and "power-hungry" autonomous devices at sea.



SP1-PSE MAR: SISTEMA DE MÚLTIPLE CAPTACIÓN Y TRANSFORMACIÓN COMPLEMENTADA DE LA ENERGÍA DE LAS OLAS DEL MAR			
Patentes propiedad PIPO Systems: Española nº200500051/200501021 PCT/ES2004/000264 PCT/EP2007/053552			
Fecha	04/06/2009	 PIPO SYSTEMS, S.L. Plaza Manuel de Pedrolo, 29 08210 Barberá del Valles BARCELONA Tel. 93 719 41 37 Fax. 93 719 41 37	
Diseño	Jordi Sola, Jordi		
Comprobado	Javier López López		
Aprobado	A. Cusani		
Materia			
Análisis			
Comentarios			
ESCALA	1:10K	Conjunto sistema PISYS	Referencia

PLOCAN: NATIONAL FACILITY FOR UNDERWATER VEHICLES, INSTRUMENTS AND MACHINES (VIMAS)

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The Oceanic Platform of the Canary Islands (PLOCAN) is a multi-purpose service facility composed by a set of large infrastructures to support research, technology and innovation in the marine and maritime sector in the North-East Central-Atlantic Ocean. PLOCAN's mission is to promote long-term observations and sustainability of the ocean. It aims to make contributions to these goals through multidisciplinary approaches, clustered expertise and cost-effective combined services, including observatories, test beds, a base for underwater vehicles, an innovation hub, and training as common element. Built by a consortium between regional and national Spanish governments, the target users are not confined within Spain's borders being international partnerships crucial to its success. The end-users should likely be groups, from both public and private sectors, and it is intended to attract international research programs and networks, academia and government. The consortium will share the cost (€50 million) for the next decade, so putting it on a sound financial footing from the start. The project was approved in 2007 as a node of the Spanish Network of Large Scientific and Technological Infrastructure (ICTS) and further supported by the Ingenio 2010 Program(1). The project is at this moment in time at the tendering stage for building and fixing infrastructures, which are scheduled for 2011. PLOCAN's operational phase is planned to start in 2012, although scientific and research activities are already taking place.

PLOCAN infrastructures are based on a set of experimental facilities and laboratories on land; an offshore platform located at the edge of the continental shelf; and deep observation sites, some of them connected via cable. So, PLOCAN

provides a suite of equipment and instrumentation for studying the diversity of waters around the site. The provision of the ocean platform is unique. It is designed to enable occupation and operation in a safe and stable ocean location, with direct access to the deeper ocean, through the provision of remotely operated vehicles, machinery and underwater work instruments, of many kinds, to observe, produce, use or install service resources at depths that up to now, were only possible for the hydrocarbon exploration and extraction industries, or from temporary floating platforms.

Combined with observatories, test beds, an innovation hub and training programs, PLOCAN offers a base for the support and development of new technology for underwater vehicles. The concept is to maintain a core of vehicles, instruments and machines (VIMAS) as a national center, and to offer services and facilities that optimize (by improving efficiency and reliability, and simplifying to reduce costs), all the operations of these ocean devices. It is hoped that this provision will attract a wide range of underwater vehicles as a working showcase of the latest technologies, as well as providing services such as testing, maintenance, transportation, development and perhaps supply. The fundamental strategy is to promote national and international collaboration to share the use of large vehicles in the area (ROV, AUVs, etc), while focusing research and development on small, light-weight, low-cost autonomous underwater vehicles such as gliders.



Testing OBS, Vilanova i la Geltrú

COMBATING BIO-FOULING OF SENSORS AND ENVIRONMENTAL PLATFORMS IN THE MARINE ENVIRONMENT

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Abstract - Biofouling is a ubiquitous natural process whereby organisms such as bacteria, algae or invertebrates form a living biological layer, typically at the interface between a solid surface and an aqueous environment. The build up of biofouling is a process that can impair the function of many artificial mechanical devices across a number of different disciplines, ranging from medicine to engineering and marine transport. This work shows the development of novel materials based on bio-inspired design and novel polymeric coatings for prevention of anti-fouling on sensor housings. Results of tested anti-fouling coatings are presented. The effect of topographic features is shown to impact on the settlement of diatoms in the early stages of biofilm formation. Novel polymeric coatings show promise in prevention of bacterial attachment. The results from the deployment of antifouling materials together with real-time water quality data from the test site is shown.

INTRODUCTION

Real-time continuous monitoring of Dublin Bay has illustrated the potential of sensor systems in management of a marine environment. Data from a YSI Hydrodata sonde collected at 10 min intervals illustrates the impact of ship movement in the port and provides an insight to when samples for biological and chemical parameters should be taken. The main challenge of sensing in the aquatic environment is biofouling of the sensors causing the data quality to degrade and increasing the cost of ownership of a monitoring system. Specifically in the marine environment, biofouling has historically been kept in check by a range of biocides and self polishing paints. The ban of TBT in 2008, has led to the need to research and develop novel alternative non-toxic antifouling strategies. Recent research has shown that physical surface micro-topography (micro-patterning) can significantly influence the rate of and strength of attachment of a marine biofilm by altering surface properties such as free energy and hydrodynamic flow or boundary layer thickness over the surface. The ability to significantly reduce or prevent biofilm formation by surface topography manipulation, inherently non-toxic in nature, would have many applications in marine and sensor

technology applications. It appears that manipulation of surface roughness and topography has already been incorporated into antifouling strategies in the marine environment by certain marine organisms and we will present the results of our research into how natural surface topographies are used by crustaceans (Figure 1), molluscs and certain fish species to control biofouling. In tandem with this we are investigating the role that engineered biologically inspired micro-textures with very specific dimensions can play in the attachment rate of particular common marine fouling species and how best microtopography can be employed practically in the marine environment to reduce fouling. In parallel, we report the use of plasticised poly vinylchloride (PVC) as a potential antifouling coating material. The materials contain a variety of sebacic and succinic acid derived plasticisers providing a variation in molecular shape and structure; diethyl succinate (DES_n), di-(2-ethylhexyl sebacate) (DEHS), dibutyl sebacate (DBS) and diethyl sebacate (DES). Each plasticiser from the sebacate group possessed the same basic C₁₀H₁₆O₄ moiety with varied dialkyl terminated groups affording a different range of homologous series plasticisers. The work investigates if branching of the side substituted alkyl chains on each plasticiser molecule affects microorganism attachment and subsequent fouling. The plasticised polymers are spin coated to create thin films for testing. In order to determine the antifouling capacity of the materials, the polymer coatings underwent a series of analyses for biomass determination, glycocalyx production and protein and carbohydrate adsorption. Topological and morphological characterisation was carried out using scanning electron microscopy (SEM) and atomic force microscopy (AFM). After an environmental study it was found that the plasticisers with increased alkyl branching, DES_n and DEHS showed the greatest degree of prevention of microorganism colonisation and attachment thus significantly reducing the initial formation of biofilms by up to 65% in some biofouling assays when compared to the uPVC blank. Results of field trials illustrate the improved performance of the novel anti-fouling materials.

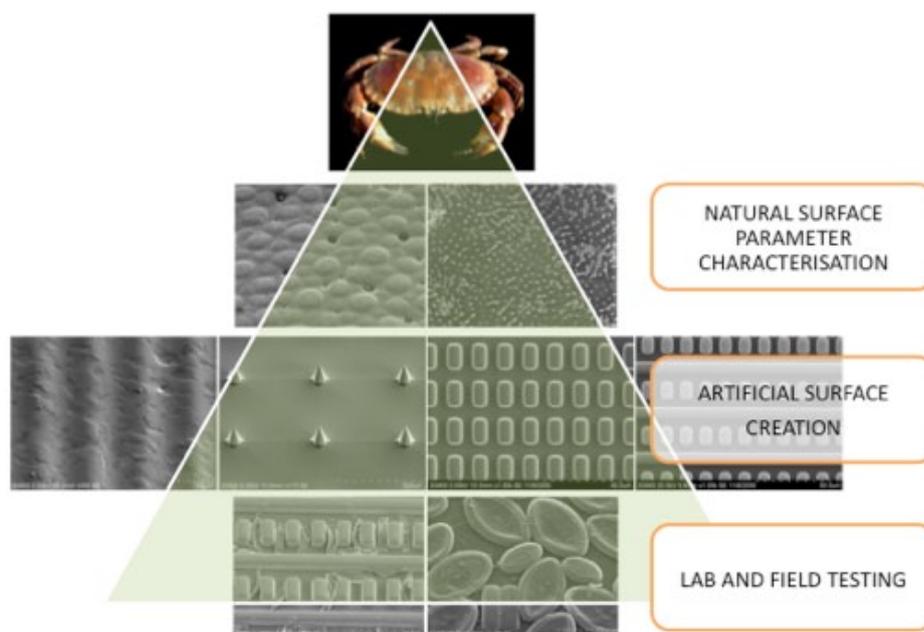


Figure 1: Strategies for the development of antifouling surfaces based on biomimetic design.

A CALIBRATION METHOD FOR THE CONDUCTIVITY MEASUREMENT AT TEMPERATURES FROM 10 °C TO 20 °C

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Abstract- The objective of this paper is to define one method for the characterization of the measurement system of conductivity on liquids at temperatures different from 25 Celsius degree. This characterization has the objective to know the average values and the uncertainty of the measured conductivity.

Keywords- conductivity, temperature, uncertainty, CTD calibration

INTRODUCTION

With the commercial conductivity meters available, nowadays it is possible to obtain measurements with its uncertainty associated at 25°C only because this is the temperature for what the conductivity standard solutions can be found with certified traceability.

In our application, the measurement equipments are located in the seafloor of the western Mediterranean coast, for what they will work in a temperature range from 10 to 20°C. Knowing the uncertainty of the measurement device in the temperature operation interval will contribute to a better reliability of the obtained data. Once measured the conductivity value, it is possible to calculate also the salinity and obtain its average value with an associated uncertainty.

PROCESS

For this calibration method, first of all a conductivity cell is required. In order to evaluate the method a custom made cell developed in our lab has been used. Once the cell has been manufactured, its associated uncertainty has been calculated using an appropriate method:

- Sensor and measurement system
- Prototype tests, linearity and interference
- Uncertainty calculation of the cell factor K for our device
- Conductivity calculation and its uncertainty for a liquid solution

DEVELOPMENT

- Sensor and measurement system

The prototype, Fig.1., is composed by a couple of cooper boards inside a plastic package. This package ensures the position stability between boards. The boards size is 10 mm x 20 mm, and its separation is 4 mm.

- Prototype tests, linearity and interference

The linearity of the system must be tested before the cell factor calculation. The objective of this test is to verify the linearity of the output current against different values of conductivity [1]. For this test we use a commercial conductivity meter, the GMH3430, and liquid samples of several conductivities that have been prepared by mixing natural water and sodium chloride (NaCl).

A Second test has been done to measure the interference between the GMH3430 and our system. A maximum interference value of 0.5% cannot be exceeded.

- Uncertainty calculation of the cell factor K for our device

This is the main point of this paper, because it is the calculation procedure for the cell factor of our system and its associated uncertainty. The used equipment for this test is:

- Climatic chamber
- Standard thermometer
- Standard solution with traceability at 25 Celsius degree
- Prototype of developed conductivity cell

When the standard solution and measurement sensors are stabilized at 25°C, a reading of the output current of the system is measured. In this example, 109 samples have been taken. The cell factor can be calculated with the equation (1) [2].

$$K = \frac{\gamma}{G \cdot (1 - \alpha \Delta T)} \quad (1)$$

Due to the fact that it is not possible to stabilize the temperature exactly at 25 °C within the climatic chamber, the correction temperature factor in (1) has been included. In the other hand, there is no need for pressure correction because the test has been done at atmospheric pressure.

Once obtained the value of K, its associated uncertainty is calculated with different contributions. The main contributions are:

- Measurements repeatability
- Error propagation (2)
- Step variation between top and bottom values
- Standard solution uncertainty

$$\delta K = \sqrt{\left(\frac{1}{G \cdot (1 - \alpha \Delta T)} \cdot \delta \gamma\right)^2 + \left(\frac{\gamma}{(1 - \alpha \Delta T) \cdot G^2} \cdot \delta G\right)^2 + \left(\frac{\gamma \cdot \Delta T}{G \cdot (1 - \alpha \Delta T)^2} \cdot \delta \alpha\right)^2 + \left(\frac{\gamma \cdot \alpha}{G \cdot (1 - \alpha \Delta T)^2} \cdot \delta \Delta T\right)^2} \quad (2)$$

The cell factor value obtained with this procedure is $K = (0,69 \pm 0,06) \text{ cm}^{-1}$.

D. Conductivity calculation and its uncertainty for a liquid solution

To calculate the conductivity of a sample and the uncertainty associated at temperatures different to 25 °C, equation (3) can be used. It expresses the conductivity as a function of temperature [2].

$$\gamma = G \cdot k \cdot (1 - \alpha \cdot (T - T_0)) \quad (3)$$

We use the standard solution because the manufacturer gives the average value of conductivity at different temperatures. Using the climatic chamber the standard solution is brought to 15 Celsius degree and then a reading of the output current of the system is taken. The uncertainty budget is detail at (4).

$$\delta \gamma = \sqrt{(G \cdot (1 - \alpha \cdot \Delta T) \cdot \delta K)^2 + (K \cdot (1 - \alpha \cdot \Delta T) \cdot \delta G)^2 + (K \cdot G \cdot \Delta T \cdot \delta \alpha)^2 + (K \cdot G \cdot \alpha \cdot \delta \Delta T)^2} \quad (4)$$

CONCLUSION

In this paper we implemented and detailed the calibration method for measurement conductivity systems. We got an average value and associated uncertainty for conductivity measurements of liquid solutions at 15 Celsius degree.

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Figure 1. Prototype

WIRELESS INTERNET LINK AND DATALOGGER FOR OCEANOGRAPHIC SENSORS

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Abstract – This paper presents a GPRS node which can collect oceanographic data from sensors with RS232 interface. The node consists of a buoy equipped with a very low cost electronics to collect, store and send information to a remote server via GPRS. Usable oceanographic instrumentation is characterized by using a digital communication interface with commands. Node has been designed as a complement to a wireless sensor network (WSN) for monitoring the hydrodynamic parameters of the Mar Menor coastal lagoon, situated in the Southeast of Spain. The need for this node is able to cover isolated sampling points which are not reachable by the nodes of the WSN deployed.

Keywords – buoy, marine environment, wireless sensor network.

1. INTRODUCTION

Fig.1 shows the wireless sensor networks necessary for monitoring certain areas of hydrodynamic interest in the Mar Menor coastal lagoon. The location of each sensor node and type is examined and justified in [1]. The distribution of the sensors, makes it possible to group them according three subnets that use ZigBee technology based on IEEE 802.15.4. This standard is applicable in situations that require secure communications, low data rate transmissions and long battery life. Figure 1 shows a node (W1) situated far away of the three networks deployed. It is 7 km to the nearest node (D4). That node allows monitoring the water discharged into the lagoon from the main agricultural water collector of the "Campo de Cartagena". Due to the great distance between it and the other nodes, it was decided to communicate the node with the remote data server using a GPRS connection. This paper describes the hardware / software architecture of this node (W1), and the structure of the buoy that supports it.

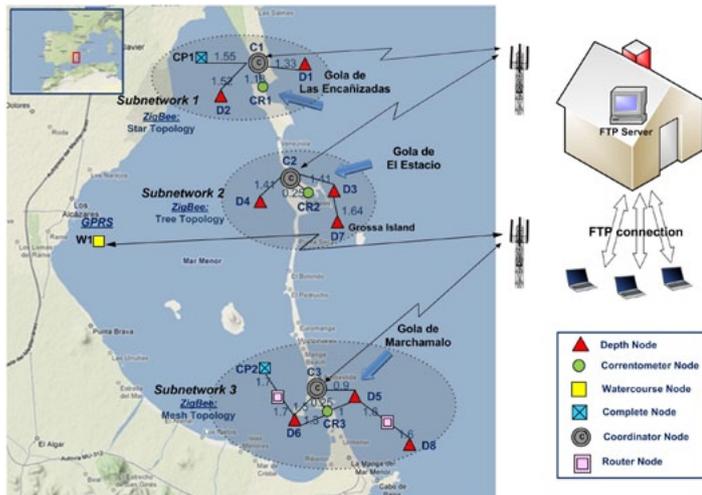


Fig. 1. Deployment of the WSN

2. NODE ELECTRONIC DESIGN

The core of the GPRS node is the intelligent communications module GE863-GPS of Telit Communications. This module has the peculiarity of including in one device connectivity to the GSM mobile phone network, with GPRS class 10 data communications. It also includes a GPS receiver (20-channel SIRF-III), a TCP/IP software stack, a FTP and SMTP client, an embedded interpreter of Python language, and non-volatile flash memory to store the developed applications. The characteristic of data transmission using the GPRS network and the inclusion of a TCP/IP protocol stack, allow establishing, on a regular basis, a connection between sensor nodes and the data server where is stored and processed the information gathered by oceanographic sensors. The use of TCP/IP allows this server may be located anywhere in the world, at any distance from the sensors,

whenever you have a permanent connection to the Internet global network. In the same way, the use of the FTP file transfer protocol eliminates the need to install special and proprietary software on the server side. As for compatibility with GSM networks, the device is quad-band type (850/900/1800/1900 MHz), ensuring its use with most GSM operators throughout the world. The Python interpreter provides embedded software development and great flexibility to add new features or to include support for sensors from other manufacturers. System power is provided by a lithium ion battery which is recharged from solar cells using a charge control circuit.

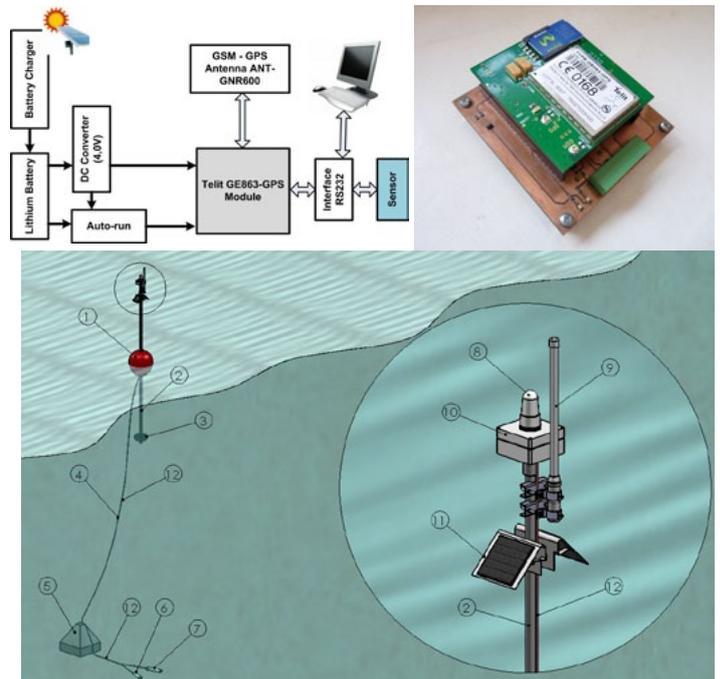


Fig. 2. GPRS node and the buoy that supports it

The instrumentation to be used with this system must have a RS232 communications interface with speeds between 300 and 115.200 bps, a communication protocol through commands, and the ability to work into a state of low energy between samples. The duty cycle of the developed application consists in sampling the sensor at programmable intervals, storing data in nonvolatile flash memory and its subsequent delivery to an FTP server via Internet and GPRS access network.

The device remains in a state of low power consumption, to preserve battery charge, until it reaches the time set by a timer according to the sampling interval required. This causes a software interruption which brings the system to full operational status. At this point, the sensor is ordered to leave their standby mode and starts the data sampling. After obtaining these, the node goes back to the low consumption mode and starts the record in the GSM network that owns the SIM card inserted in the module. If the record is successfully achieved, we proceed with the GPRS connection through the appropriate APN. The next step is to connect to the global Internet network using TCP/IP and obtaining its own IP address. To transmit the data collected provides a bidirectional connection to the server resolving the domain name by using DNS and FTP as the transfer protocol. If the transfer is successfully completed, the connection is closed and the device returns to standby mode until the next cycle. In case of errors, at any point in the process, they are stored in a text file and sent on the next successful connection or even if it is possible, and the seriousness required, they are sent as SMS messages to a mobile terminal. Each cycle, the software monitorize the sys-

tem global position using the integrated GPS receiver. This position is compared to a reference stored in the buoy deployment moment. If significant changes are detected, it is interpreted as an unwanted displacement due to a broken anchor or sabotage. In this case, an alarm is released by sending SMS messages with current position.

3. BUOY DESIGNED

As important as the electronic development is the design of the mechanical structure of the buoy. The deployment of a WSN in the marine environment involves more difficulties than on land and therefore the importance of ad-hoc design to deployment characteristics [2]. Moreover it must be considered several requirements, some of these are the visibility for sea traffic, the use of the eco-material, stable behavior in adverse atmospheric conditions, low cost, lightweight, electronics housing free of the condensation phenomenon and design watertight packages. Other important factor is the mooring system to maintain horizontal the buoy and to prevent twists.

Fig. 2 shows the buoy designed. It is a vertical structure which includes the different components required [2]. The communication antenna (9), the beacon light (8), the electronic mote and battery housing (10) and solar panels (11) are situated on top of the buoy. There is a float (1) on middle of the tube (2) and a counterweight (3) on bottom of the structure to provide stability to the buoy. Moreover, an anchor (4)(5) is situated on bottom of the sea to avoid displacement of the buoy location. Finally, oceanographic sensors (6)(7), on bottom of the sea, are connected with the electronic equipment (mote) on top of the buoy.

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MONITORING THE LUCKY STRIKE VENT FIELD IN REAL TIME

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Abstract: This paper describes the deployment and first results of an acoustically-linked multidisciplinary observing system at the Lucky Strike vent field, with satellite connection to shore.

Keyword: hydrothermal vents, deep sea observatory, Mid Atlantic Ridge

INTRODUCTION

Hydrothermal circulation at mid-ocean ridges is a fundamental process that impacts the transfer of energy and matter from the interior of the Earth to the crust, hydrosphere and biosphere. The unique faunal communities that develop near these vents are sustained by chemosynthetic micro-organisms that use the hot fluid chemicals as a source of energy. Environmental instability resulting from active mid-ocean ridge processes create changes in the flux, composition and temperature of emitted vent fluids and influence the associated hydrothermal communities.

The MoMAR (which stands for Monitoring the Mid-Atlantic Ridge) project was initiated 10 years ago by the InterRidge Program to promote and coordinate long-term multidisciplinary monitoring of hydrothermal vents at MAR. It aims at studying vent environmental dynamics from geophysics to microbiology. More recently, the MoMAR area has been chosen as one of the 11 key sites of the European project ESONET NoE. MoMAR-D was selected as a demonstration mission to deploy and manage a deep sea observatory at Lucky Strike for one year. Monitoring this large hydrothermal field, located in the centre of one of the most volcanically active segment of the MAR, will offer a high probability of capturing evidence for volcanic events, observing interactions between faulting, magmatism; hydrothermal circulation and, evaluating their impact on the ecosystem.

DEPLOYMENT

The observatory infrastructure is composed of two Sea Monitoring Nodes (SEAMON) acoustically linked to a surface relay buoy (BOREL, Fig. 1), ensuring satellite communication to the land base station in Brest (France). The entire system was deployed during the MoMARSAT cruise (The Pourquoi Pas ? /Victor6000, <http://www.ifremer.fr/momarsat2010/>) in October 2010. A first SEAMON node, dedicated to large scale geophysical studies, was moored in the centre of the large lava lake present in the Lucky Strike vent field. This node

hosts an Ocean Bottom Sismometer (OBS) and a permanent pressure gauge (JPP) that were connected underwater using wet matable connectors (Fig.2). A second node was deployed at the base of the Tour Eiffel active edifice to study the links between faunal dynamics and variations of physico-chemical factors. This node is composed of a High Definition (HD) video camera, 6 LED lights, an Aanderaa optode (oxygen, temperature) and two in situ chemical analysers. These two nodes communicate via underwater acoustics to a BOREL buoy that is moored on the ocean surface within acoustic range of the SEAMON stations. This buoy is equipped with two identical and back up data transmission channels to ensure uninterrupted data flow. Scientific and technical data (including a low-resolution photo) are transmitted daily to the data centre in Brest. Autonomous instruments (OBS, ocean bottom tiltmeter, current meters, particle trap, colonisation experiments and temperature probes) were also deployed in the LS vent field. They will store their data for the whole duration of the experiment (1 year).

RESULTS

Treatment of data sets will be conducted in two stages: in near real time for the subset that is transmitted through the SEAMON system; and after the 12 months for the whole data set. The near real time data will serve both as support for scientific interpretation, and as an indicator that an event is occurring. Volcanic (eruption, underground dike event, or rapid degassing of the magma chamber), tectonic (displacement along axial faults), or hydrothermal events are all expected to occur on the MAR. Understanding the impact of these events on biological communities is one of our key objectives. The data can be viewed online, according to ESONET data policy and European directives (now, temporary access through <http://www.ifremer.fr/WC2en/allEulerianNetworks>). The system should be recovered in summer 2011 after 12 months on the bottom.

ACKNOWLEDGEMENTS

This work is partly funded by the European network of Excellence FP6-ESONET (PI R. Person, Ifremer, grant agreement 36851) and the European FP7-HERMIONE Collaborative Project (PI P. Weaver, grant agreement 226354).



Fig. 1: The Borel buoy was moored North of the lava lake. © Ifremer MoMARSAT2010

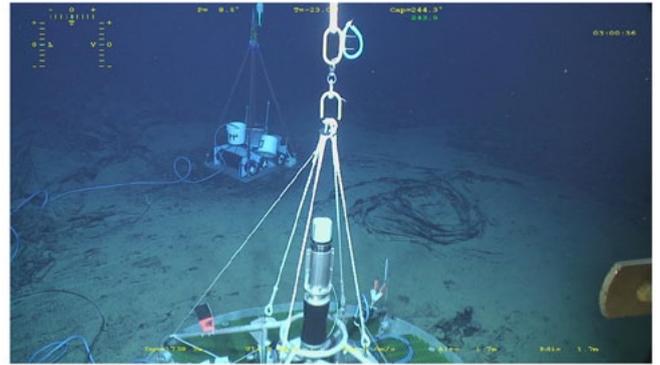


Fig. 2 Seamon East was deployed on the lava lake, © Ifremer MoMARSAT2010

HYDRODYNAMIC MODEL, SIMULATION AND LINEAR CONTROL FOR CORMORAN-AUV

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Abstract—this work shows the mathematic calculation for obtention of a Cormoran-AUV hydrodynamic model, it also shows a linear control design for a path tracking. The model has been simplified to three degrees of freedom of movement and the whole system has been simulated using Matlab Simulink Software. The system has been linearized for different velocities to design a linear control for each one of them. However, all resulting systems can be controlled by a unique linear control due characteristics of the vehicle. The designed control is a PD controller, which avoids the position error since the pole of the vehicle model is at the origin. Different paths have been simulated using this control and their results have been compared in both rising time as establish time.

Keywords—Hydrodynamic model, linear control, autonomous underwater vehicle.

I. INTRODUCTION

Cormoran (see figure 1) is a low cost oceanic observation vehicle, hybrid between AUV (Autonomous Underwater Vehicles) and ASV (Autonomous Surface Vehicles), which has been built in Mediterranean Institute of Advanced Studies (IMEDEA) of Mallorca (Spain) by the oceanographic group, in collaboration with the University of the Balearic Islands.

The principle of movement is based on the navigation over the marine surface where the vehicle follows a predetermined path in the mission. The path is defined by a series of waypoints, in which the vehicle stops and dives vertically to obtain a profile of a water column. Subsequently, the vehicle rises to the surface and transmits the most relevant data (temperature, salinity, depth and global position using GPS) through GSM messages. After sending this data, the vehicle continues to the next waypoint defined by the mission [1].

II. 3 DOF HYDRODYNAMIC MODEL OF THE VEHICLE

Due to the movement described before, heave, roll and pitch are not taken into consideration. Therefore the characterization of the vehicle can be achieved through a three degrees of freedom that include the advance (x), the lateral displacement (y) and yaw angle (ψ) [2].

A. Vehicle dynamics

Once the general model of marine vehicles is simplified, we obtain 3 equations



Fig. 1. Cormoran-AUV.

shown in (1), (2) and (3), which are functions of speed, mass, vehicles' propulsion and a set of hydrodynamic coefficients.

$$m\dot{u} - mvr = X_{\dot{u}}\dot{u} - Y_vvr - Y_r r^2 + X_{|u|}u|u| + X_{prop} \quad (1)$$

$$m\dot{v} + mur = Y_{\dot{v}}\dot{v} + Y_{\dot{r}}\dot{r} + X_{\dot{u}}ur + Y_{|v|}v|v| + \quad (2)$$

$$Y_{r|r}r|r| + Y_{uvf}uv + Y_{urf}ur + Y_{uuf}u^2\delta_r$$

$$I_z\dot{r} = N_{\dot{v}}\dot{v} + N_{\dot{r}}\dot{r} + Y_{\dot{r}}ur - (X_{\dot{u}} - Y_{\dot{v}})uv + \quad (3)$$

$$+ N_{|v|}v|v| + N_{r|r}r|r| + N_{uvf}uv +$$

$$+ N_{urf}ur + N_{uuf}u^2\delta_r$$

To simulate these equations in Simulink software of matlab is necessary taken to consideration that no algebraic loops are present. This requires re-express equations (1), (2) and (3) in order for them to be solved for the velocity vector v . Figure 2 shows the final expression in Simulink environment.

III. LINEARIZATION OF THE SYSTEM

First of all, It is necessary to obtain a system linearization in order to design a linear control system [3]. The model is linearized around the speed, assuming that the forward speed u is constant and v and r speeds are smaller compared to the forward speed, several velocities were used to linearize the system. Similar approaches are made in works on the Remus vehicle [4], as well as the AUV- Infante [5]. Applying Taylor series approximations [6], linear vehicle model is achieved, expressed in matrix form (4). In this model, the propulsion engine X_{prop} and rudder angle δ are considered inputs to the system.

$$\begin{bmatrix} -2X_{u|u} & 0 & 0 \\ 0 & -Y_{uvf} & m - X_{\dot{u}} - Y_{urf} \\ 0 & X_{\dot{u}} - Y_{\dot{v}} - N_{uvf} & -Y_r - N_{urf} \end{bmatrix} \begin{bmatrix} \Delta u \\ \Delta v \\ \Delta r \end{bmatrix} u_0 + \begin{bmatrix} m - X_{\dot{u}} & 0 & 0 \\ 0 & m - Y_{\dot{v}} & -Y_r \\ 0 & -N_{\dot{v}} & I_z - N_{\dot{r}} \end{bmatrix} \begin{bmatrix} \Delta \dot{u} \\ \Delta \dot{v} \\ \Delta \dot{r} \end{bmatrix} = \begin{bmatrix} X_{prop} \\ Y_{uvf} u_0^2 \Delta \delta_r \\ N_{uvf} u_0^2 \Delta \delta_r \end{bmatrix} \quad (4)$$

IV. CONTROL DESIGN

A controller must be developed to track a predefined path. The controller must lead the nonlinear system to a desired dynamic. This dynamic is defined in (5), which specifies the maximum overshoot and settling time desired.

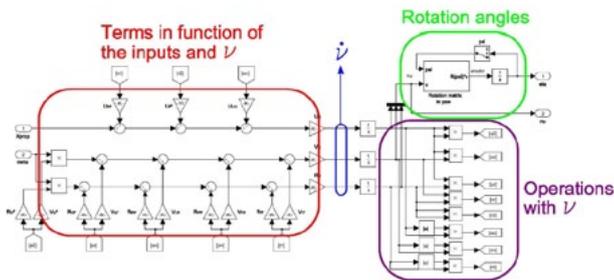


Fig. 2. Simulink implementation

$$\xi \leq 0.707$$

$$t_{ss} \leq 0.8 \text{ seg}$$

A. PD controller

Since the linearized model with yaw as output has a pole in the origin, PD controller is enough to eliminate the position error and achieve the desired dynamic area. For example, the equation (6) shows the design of the PD controller for constant velocity of 0.3m/s.

$$G_c(s) = 22.25(s + 5.44) \quad (6)$$

Eventhough PD controllers were calculated for different velocities, only one is needed to move the poles of all systems to the target zone, specifically, the control designed for the smallest velocity, 0.3 m/s.

RESULTS

A unique linear controller has been applied to the vehicle as it is described above. Figure 3 shows the S-plane representation of the system's poles in closed loop for linearizations for different velocities ranging between 0.3m/s and 0.6m/s. When increasing speed, the poles become more stabiles and with less imaginary part. Poles at smallest velocity are the poles on the boundary of the target zone.

Figure 4 shows the step response with the yaw as output for two forward velocities: 0.3m/s and 3.3m/s. It also shows a better performance at high velocities, where the overshoot and settling time are lower than in low velocity. In both

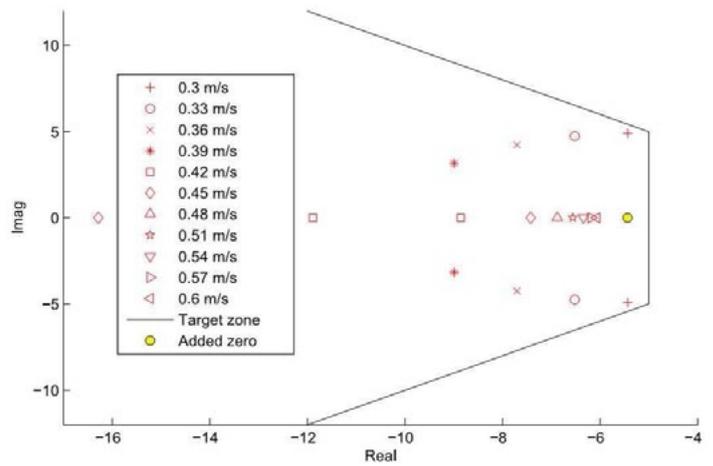


Figure 3. closed loop poles applying PD controller

velocities, the position error has been eliminated. Figure 5 shows the misfit of the vehicle in the XY plane because an implicit control of the yaw angle over time is used.

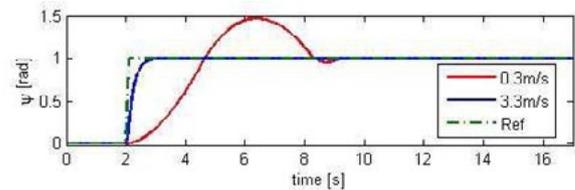


Figure 4. Step response using PD controller in the non-linear model

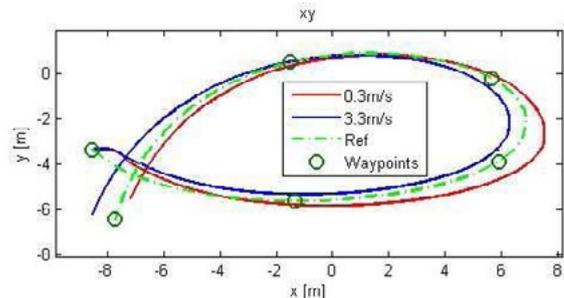


Figure 5. Path tracking using waypoints.

CONCLUSIONS

This paper presented a nonlinear model of the Cormoran vehicle using three degrees of freedom. The model has been linearized at different velocities to analyse their behavior. In order to develop a path tracking, a PD controller has been designed to control all the system. It showed that is possible to define a desired dynamic area in the S-plane for the systems' poles, where the position error is eliminated. Also, the results showed that as speed increases better performance in the desired dynamic is achieved. For this reason a unique PD controller is enough to control the vehicle.

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ANOMALIES OF OXYGEN MEASUREMENTS PERFORMED WITH AANDERAA OPTODES

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Abstract

Four sets of measurements performed between 2005 and 2010 in the deep central Atlantic, and in deep Mediterranean Sea, and the Arctic Ocean revealed a strange performance of Aanderaa Optode 3830 sensors mounted on RCM11 current meters in low current regimes (current speeds > 10 cm s⁻¹).

All oxygen data sets collected during these deployments showed significant drops of oxygen (of the order of 50-100 $\mu\text{mol/l}$) affecting the Optode data stability in low hydrodynamic conditions (fig.1). High correlations between all acquired parameters (i.e. temperature, turbidity, speed and direction of currents) allowed verifying that no unusual event perturbed the mooring areas during the periods of acquisition, although natural events responsible of so abrupt, short and intense oxygen varia-

tions can't be easily found.

Despite the well-known performance of the Aanderaa Optodes, these experiences suggested that the data acquired by optodes installed on RCM11s could not be always reliable, especially in low energy systems (typical for the deep ocean) and that current speeds should always be considered in order to verify the reliability of the data recorded.

A series of test in controlled water condition was performed in order to better understand eventual sensor dependence on speed current variations and to evaluate sensor stability in quasi-stationary water.

Keywords: Oxygen, Optode, deep-sea, current meter, long-term measurement

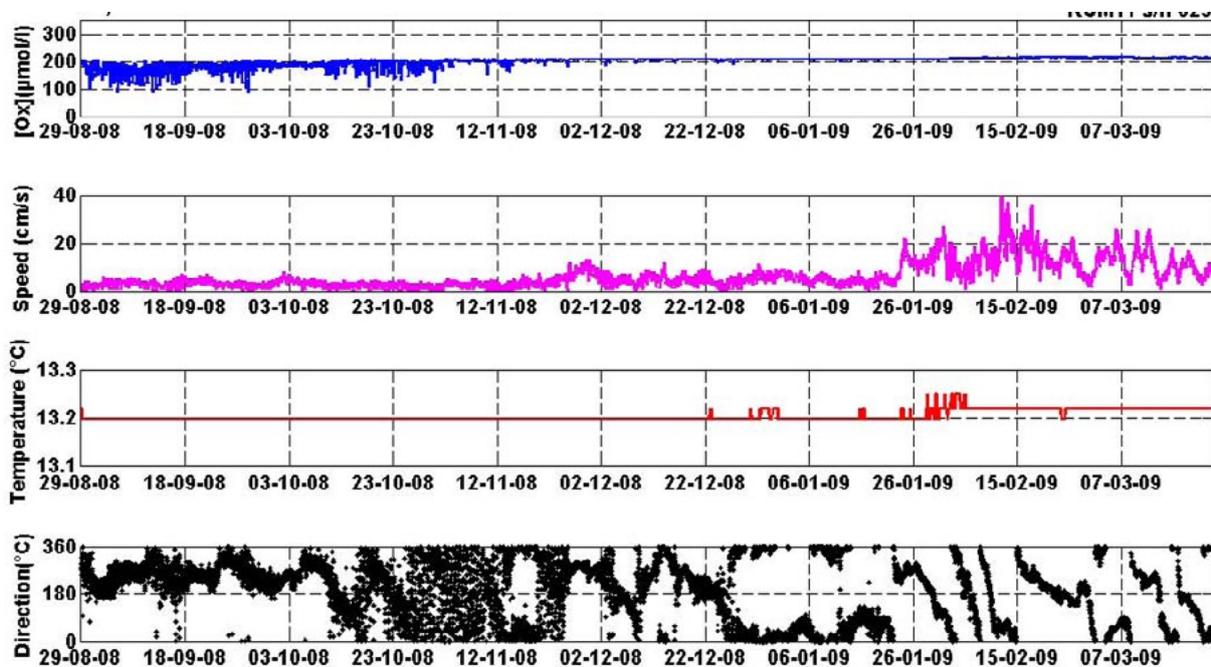


Fig.1: Example of data affected by unexpected oxygen drops. The series, 219 days long, was acquired during the DEEP experiment in the Gulf of Lion. The measurements was collected by RCM11+ Optode 3880 moored at 2256 m depth.

NAIVE BAYES CLASSIFIER FOR AUTOMATIC ANALYSIS OF BELUGA WHALE SONGS

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Abstract - Very little is known about the way cetaceans and particularly beluga whales communicate. However as scientists and biologists investigate it is observed the extraordinary adaptation of the cetacean communication system to the underwater medium and the surprising communication skills. The ultrasonic sound emitted by beluga whales can be identified in what some scientists call vocalizations and related to animal behavior. The signal processing group GTS (iTEAM) of the Universitat Politècnica de València alongside with the Oceanogràfic have developed an automatic system for continuously monitoring beluga whale sounds. This system is intended to establish new behaviour patterns and help biologists to obtain a better understanding of beluga whales. The present work is devoted to the comparison of the different Naive Bayes classifiers into the automatic monitoring system.

Keywords: Statistical signal processing, Signal detection and classification, Bioacoustics.

1. INTRODUCTION

Previous studies have shown that the analysis of the beluga vocalizations patterns is a good tool to evaluate their communication and welfare state [1]. The correlation obtained between vocalizations and behaviors show up that their vocalizations are strongly influenced by external stimulus. The first impression when beluga vocalizations are heard for the first time is that there are an endless variety of sounds. Nevertheless, time-frequency analysis shows that there are a limited number of patterns and they are repeated. The researchers from the Signal Processing Group (iTEAM) trained an automatic algorithm, after having worked with large amount of data picked up from long time periods of direct visualization. The classification system is based on statistical analysis from the acoustic signal received by the hydrophone [2]. The developed system was appropriated for designing experiments that help to understand a bit more the beluga behavior.

This paper is focused on analyzing the best vocalization classifier for the system. In order to do that, a comparative among Naive Bayes distributions (Gaussian, Kernel, Multinomial and Multivariate multinomial) is presented.

2. BELUGA WHALE SOUNDS AND THEIR RELATION TO ANIMAL BEHAVIOR

Studies of the vocalizations emitted by the Oceanogràfic beluga whales (Kairo and Yulka) have allowed scientists to obtain a large collection of sounds. These studies started in 2003 when both whales arrived at the installations of the Ciudad de las Artes y las Ciencias from the Mar del Plata, in Argentina. A comparison between vocalizations rate and animal welfare was done. This comparative study demonstrated that during stress periods (such as those produced by air transport to new facilities or beluga pregnancy) acoustic activity decreased significantly [1]. Additionally, a set of classification categories for beluga sounds was created. All this work was done manually listening one by one a large number of records and analyzing with the aid of the spectrogram how the energy was distributed in time and frequency. This process is tedious and time consuming and can not be maintained 24 hours a day. Instead of continuous inspection, researchers analyze only a few minutes a day of the recordings. Recently, the Instituto de Telecomunicacion y Aplicaciones Multimedia (iTEAM) has begun to collaborate with the Oceanogràfic researchers to employ automatic classifiers which allow a continuous examination of the emitted sounds.

We pretend to use a simple classification scheme that will help to establish relationships among sounds and behaviors. The quantity of vocalizations produced by belugas, or cetacean in general, reaches an extensive number of data with complex and rapidly repeated clicks [3]. In order to create a simple set of categories all the vocalizations will be classified in three groups: tonal, pulsed and Jawclap sounds. In this study the echolocation clicks are not taken into account and they have been manually removed from the recordings. Echolocation is broadly studied in many species and seems to be used by the animals as a biological sonar instead of having communicative purposes.

Tonal sounds are characterized by narrow bandwidth squeals and whistles, giving out a very concrete component clearly detected in frequency. Differ-

ences such as the number of frequencies during the same period of time can be found. When belugas produce more than one frequency simultaneity is called multitone vocalization in contrast when an isolated frequency component is detected, called as a simple tonal one. In most cases tonal sounds seem to have communicative nature.

Pulsed sounds look like short broadband clicks (see figure 1). These kind of vocalization can be related to communicative or aggressive behaviour. A different kind of pulsed sound is the Jawclap. The mechanisms that beluga whales use to generate this sound is completely different to the mechanism employed to generate other pulsed sounds. Due to the aggressive meaning associated to this sounds a specific category has been created. Zookeepers and biologists from Oceanogràfic were fundamental in the development of this classification scheme.

In addition to single vocalization it is frequently found combinations of two or more individual vocalizations. These combinations are usually associated with special situations and specific stimulus which make difficult to distinguish one category or another. This kind of signals, that will be referred in this work as mixed signals, are composed of various vocalizations concatenated or overlapped in time. The classification algorithm must consider this extraordinary capability of belugas. The mixed signal can be composed of a tonal-pulsed mix or a pulsed-jawclap mix. An example of this flexibility to produce sounds is illustrated in the figure 1 where the combination of a pulsed and a jawclap are really close in time.

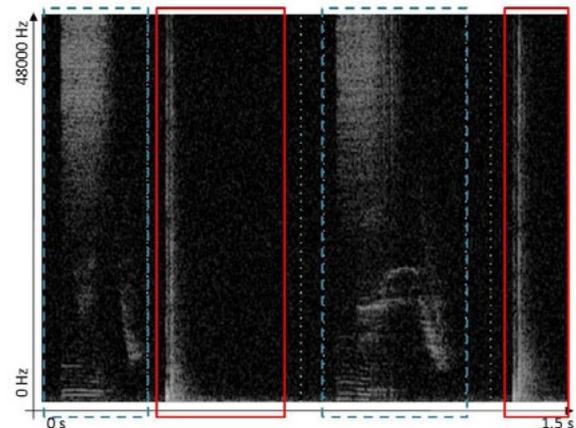


Fig. 1: Spectrogram of beluga whale vocalizations showing two alternated pulsed vocalizations (blue square) and Jawclaps (red square)

3. BRIEF DESCRIPTION OF THE AUTOMATIC CLASSIFIER OF BELUGA WHALE SOUNDS

The recorded vocalizations were provided by the Oceanogràfic biologists. Sounds were acquired in the Oceanogràfic facilities using a single hydrophone, an acquisition card and a computer. For this preliminary study an Excel table with the relative time when each vocalization started. Their duration and the manual classification was also supplied.

The classification has been done using MATLAB and the MATLAB Statistic toolbox. This work has been focused on comparing for this specific application a set of Naive Bayes classifiers and choosing the most appropriated. A Naive Bayes classifier is a probabilistic classifier based on Bayesian statistics with strong independence assumptions. It classifies data in two steps; firstly, using the training samples estimates the parameters of a probability distribution and secondly, it predicts the probability of that sample belonging to each class. The class-conditional independence assumption simplifies the training step. It allows a better estimate of the Naive Bayes parameters required for accurate classification, and uses less training data than other classifiers.

All the steps and decisions involved in sampling data affect the pattern, so the

choice of the distinguishing features is a critical step to design [4]. In order to improve the accuracy of classification, it is essential to choose the features that can capture the temporal and spectral characteristics of signals. After several empirically combinations, table 1 shows the features chosen: features 1-9 are frequency parameters related to resonances, bandwidths and power spectral amplitudes. Features 10-13 give statistical information related to higher order moments of the vocalization [5]. Feature 18 is inspired in the human voice parameters obtained in LPC (vocoder) models [6]. This parameter gives information of the residual prediction error. Finally features 14-17 give higher order statistical information of the residual prediction error (feature 18).

NUMBERTS	FEATURES
1	Fundamental frequency f_0
2	Q-Factor of $f_0 = \Delta f_0 = f_0$
3	Power Spectral Density at frequency $f_0 S_x(f_0)$
4	Fundamental frequency f_1
5	Q-Factor of $f_1 = \Delta f_1 = f_1$
6	Power Spectral Density of frequency $S_x(f_1)$
7	Fundamental frequency f_2
8	Q-Factor of $f_2 = \Delta f_2 = f_2$
9	Power Spectral Density of frequency $S_x(f_2)$
10	"Skewness" of the vocalization (as described in [5])
11	"Kurtosis" of the vocalization (as described in [5])
12	Autocovariance test of the vocalization (as described in [5])
13	Temporal reversibility of the vocalization (as described in [5])
14	"Skewness" of the sonority signal
15	"Kurtosis" of the sonority signal
16	Autocovariance test of the sonority signal
17	Temporal reversibility of the sonority signal
18	Sonority signal (as described in [6])

Table 1: Brief description of the features vector employed in the automatic classifier.

4. COMPARISON AMONG CLASSIFIERS DISTRIBUTIONS

In order to optimize the performance of the classifier, all the characteristics were tested by a training set. The objective was reducing the eighteen features shown in table 1. The algorithm of sequential selection was created for selecting and ordering the most representative characteristics for each distribution [7]. The results are shown in table 2. The steps were followed by:

- An objective criterion to minimize all the possible characteristics of the subsets.
- A sequential searching algorithm which adds or eliminates the characteristics subsets when the criterion is evaluated. This sequential searching allows testing feature to feature, using the called Sequential Forward Selection (SFS) [7].

The classification set was composed of 313 vocalizations where the most representative 50 were chosen for the training set. During the training phase a category label or cost for matching the pattern was provided. It was seek to reduce the sum of the costs for the pattern (tonal, pulsed and jawclap sounds). Figure 2 evaluates the error when classifying Gaussian, Kernel, Multinomial and Multivariate multinomial density functions as the number of features is increased. In addition to these classifiers (based on Naive Bayes), two discriminant analysis classifiers were also compared because of their covariance matrices similarities with Naive Bayes (diaglinear and diagquadratic). A brief outline of the compared distributions are:

- The 'normal' distribution is appropriate for features that have normal distributions in each class. For each feature you model with a normal distribution, the Naive Bayes classifier estimates a separate normal distribution for each class by computing the mean and standard deviation of the training data in that class.
- The 'kernel' distribution is appropriate for features that have a continuous distribution. It does not require a strong assumption such as a normal distribution and you can use it in cases where the distribution of a feature may be skewed or have multiple peaks or modes. It requires more computing time and more memory than the normal distribution. For each feature you model with a kernel distribution, the Naive Bayes classifier computes a separate kernel density estimate for each class based on the training data for that class.
- The multinomial distribution is appropriate when all features represent counts of a set of words or tokens. The classifier counts the set of relative token probabilities separately for each class. The classifier defines the multinomial distribution for each row by the vector of probabilities for the corresponding class.
- The multivariate multinomial distribution is appropriate for categorical features. For each feature you model with a multivariate multinomial distribution, the Naive Bayes classifier computes a separate set of probabilities for the set of feature levels for each class.

For each one, the optimal ordination to minimize the training error was solved (see table 2). The best classifier during the training set was the one based on Naive Bayes with Multivariate multinomial configuration. It achieved less than 1% error with just only for features (1, 4, 3 and 6). The "Kernel" distribution was the second best distribution which uses 11 features to get less than 5% error. The others classifiers have similar behavior with up to 20% error, being the Multinomial distribution the worst classifier during the training set.

It is important to emphasize that the errors obtained in the training test in table 2 will be lower than the errors that will be later obtained in the test set (next section).

5. RESULTS

In order to check the classifier efficiency, results were compared on a different vocalization set processed and manually classified by the Oceanogr'afic biolo-

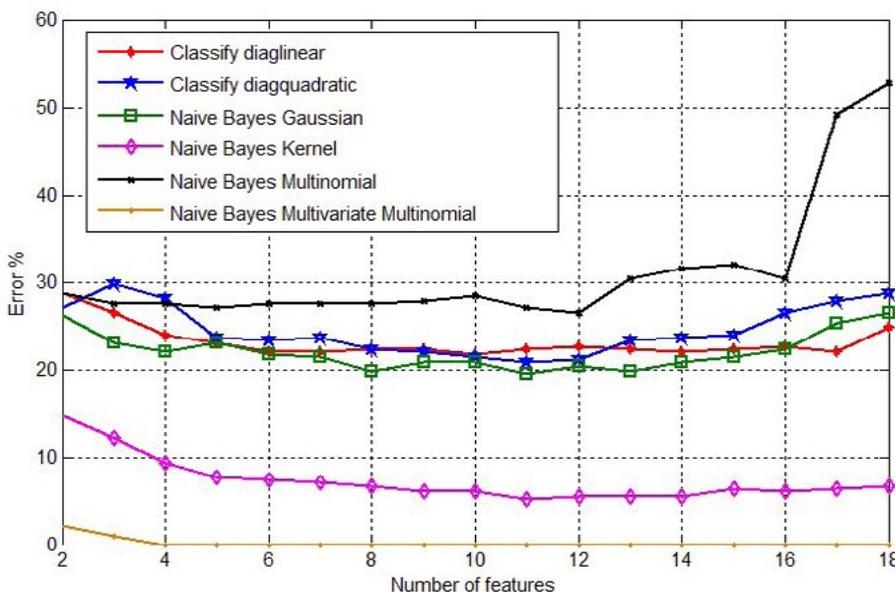


Fig. 2: Comparative among the different classifiers distributions and the number of features used for their evaluation.

gists. This set was tested for all the classifiers and the results are shown in table 3. The table presents the classification rate for all Bayes classifiers for the optimal number of features and for the whole set of eighteen features. It also shows the percentage number of vocalizations that are not classified (missing rate). When the order and the number of features is optimum, the classification rate will be the best. Table 3 shows also that if mixed signals are not considered classification

Clasificador	Sorted Significant Features	Opt. #	Error
Diaglinear	6,15,2,10,5,17,12,7,9,14,11,1,4,16,18,3,8,13	10	21.43
Diagquadratic	9,15,3,10,2,18,11,7,1,17,14,16,4,13,8,5,16,12	11	20.77
N.B. Gaussian	1,15,6,11,8,17,9,14,18,10,2,7,3,4,13,5,16,12	11	19.49
N.B. Kernel	12,16,6,2,10,13,7,15,1,4,18,8,17,3,11,14,9,5	11	5.11
N.B. Multinomial	9,15,6,3,10,12,16,18,13,1,14,17,4,7,11,2,8,5	12	26.52
N.B. Multivariate Multinomial	1,4,3,6,7,8,5,9,10,11,12,13,14,2,15,16,17,18	3	0.96

Table 2: Optimal number of features and most significant features sorted from more to less significance (N.B.=Naive Bayes).

percentages increase for all classifiers excepting the Naive Bayes Multivariate Multinomial. Naive Bayes Multivariate Multinomial classifier reaches a 98.7% of classification rate, but it has a 30% missing rate (vocalizations that was not able to assign to any category). It shows up that if it does not have a clear decision about each vocalization, it will not classify the signal. In spite of when the classifier does it, the algorithm classifies successfully. In addition, this classifier has the distinction to obtain the same classification rate when it uses all the eighteen features or when it uses the optimum order number of features. This is because the features added do not cause any confusion, unlike the other classifiers do. The Naive Bayes kernel classifier using the optimum order and number of features without mixed signals obtains the best results, specifically a 89.2% classification rate and just a 0.2% missed signals. On the other hand, the classifier Naive Bayes Multinomial has the worst classification rate (66.6%), but the Gaussian obtains a good one (81.8%). Either of them do not have missed signals. The percentages for the diaglinear and diagquadratic classifiers (not shown in table 3) are quite similar to those given for the Naive Bayes Gaussian distribution.

6. CONCLUSIONS AND FUTURE WORK

The study presented here showed that the best classifier for the system was the Naive Bayes following a kernel distribution with the optimum number of features. The percentages achieved for this classifier for the whole set of vocalizations (including consecutive and partially overlapped vocalizations) was 84% of detection probability with just 1.7% of vocalizations that the algorithm was not able to classify. This study has shown that it is possible to create a real time classifier to analyze beluga sounds the 24 hours a day.

The percentages achieved are quiet good, but they could be improved if a more precise classifier that could take into account the mixed vocalizations was employed. It has to be known that the number of mixed vocalizations is not negligible. In fact, in the vocalizations files we have analyzed approximately the 20-25% of vocalizations were marked by the biologists as mixed vocalizations. In order to get this goal the authors propose as future lines:

- Pyramidal analysis in time and fusion of the different classifiers to decide whether it is a single vocalization or a mixed one.

- Combining a low resolution classifier based on spectrogram correlation with the proposed Naive Bayes classifier.

Increasing the number of categories will be done as a more precise beluga behavior knowledge is achieved. Open sea tests of the proposed algorithm for different species (dolphins) and the possibility of integrating the proposed algorithm in underwater buoys is also planned.

7. ACKNOWLEDGEMENT

The authors thanks very much to Jose Antonio Esteban from Oceanogr`afic who prepared all experimental analysis for deployment. This work was supported by the C`atedra Telef`onica - UPV, the national R + D program under Grant TEC2008-02975 (Spain), FEDER programme and Generalitat Valenciana PROMETEO 2010/040.

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Naive Bayes Multivariate multinomial Distribution				
	Optimal Features		All Features	
	All Signals	No mixed sign	All Signals	No mixed sign
Noise	100%	100%	100%	100%
Tonal	97.3%	97.3%	97.3%	97.3%
Pulsed	100%	100%	100%	100%
Jawclap	100%	100%	100%	100%
No classification	40.1%	30.0%	40.1%	30.0%
Total	98.7%	98.7%	98.7%	98.7%
Naive Bayes Kernel Distribution				
	Optimal Features		All Features	
	All Signals	No mixed sign	All Signals	No mixed sign
Noise	96.2%	96.2%	97.1%	97.1%
Tonal	85.4%	89.1%	78.4%	80.7%
Pulsed	66.0%	74.7%	67.0%	76.3%
Jawclap	63.9%	83.3%	71.4%	97.1%
No classification	1.7%	0.2%	2.1%	0.2%
Total	84.2%	89.2%	82.1%	86.7%
Naive Bayes Gaussian Distribution				
	Optimal Features		All Features	
	All Signals	No mixed sign	All Signals	No mixed sign
Noise	91.3%	91.8%	93.1%	93.6%
Tonal	71.2%	76.4%	76.0%	84.2%
Pulsed	60.5%	69.2%	59.3%	67.5%
Jawclap	50.3%	60.0%	37.0%	32.1%
No classification	0.0%	0.0%	0.0%	0.0%
Total	77.0%	81.8%	74.3%	79.4%
Naive Bayes Multinomial Distribution				
	Optimal Features		All Features	
	All Signals	No mixed sign	All Signals	No mixed sign
Noise	69.1%	75.2%	69.6%	73.6%
Tonal	58.8%	60.4%	56.6%	53.6%
Pulsed	32.1%	40.5%	31.5%	37.1%
Jawclap	31.3%	50.0%	66.7%	83.3%
No classification	0.0%	0.0%	0.0%	0.0%
Total	60.5%	66.6%	58.6%	62.6%

Table 3: Comparative distribution percentages among different distributions. (Up-Down) N.B. multivariate multinomial, N.B. kernel, N.B. Gaussian and N.B. multinomial

TARGET DETECTION METHODS IN THE RAUVI PROJECT

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Abstract - Recent advances in underwater technology and robotics open the possibility for intervention field operations to be carried out with AUVs. Possible applications include wreck rescue, marine science, offshore maintenance and any task needing manipulation skills. In this context, RAUVI is a three years research project funded by the Spanish Government whose objective is to develop and validate a generic methodology for autonomously performing multipurpose intervention missions in underwater environments. RAUVI was split in three subprojects led by the Universitat Jaume I de Castelló (UJI), Universitat de Girona (UdG) and Universitat de les Illes Balears (UIB), respectively. This manuscript describes part of the activity developed by the UIB subproject, responsible for the vision-based methods providing information to the whole system. Specifically, the target recognition methods developed to carry out the project second-year demonstration are exposed. Due to the specific characteristics of the experiments designed, the methods developed take advantage of the colour information to detect the object to be manipulated. The frame of the project is introduced, the specific vision methods are described and some results are presented.

Keywords - Intervention AUV, Colour-based object recognition.

1. INTRODUCTION

Autonomous Underwater Vehicles (AUV) is a State-of-the-Art technology for survey tasks. Besides, operations requiring manipulation skills, very common in the offshore industry, the marine science or in rescue missions, are traditionally carried out by divers, manned submersibles or Remotely Operated Vehicles (ROV). Attempts to develop AUVs with intervention capabilities (I-AUV) started in the mid 90's and resulted on pioneering prototypes, mainly conceived as research test beds, like ODIN from the University of Hawaii or VORTEX/PA10 conceived in the context of the UNION European. More recently, ALIVE has been designed for panel intervention in the oil industry and SAUVIM is oriented to seabed object recovery. RAUVI (Reconfigurable AUV for Intervention) is a research project started in 2009 and granted by the Spanish Government. The main goal of RAUVI is to develop and validate a generic methodology, and its necessary technologies, to autonomously perform multipurpose underwater light intervention missions. To that end a generic methodology has been proposed in which the missions are split in two phases: first, the survey, where the vehicle explores the region of interest gathering visual and acoustic data of the region of intervention, synchronized with robot navigation; second, the intervention, where the robot goes back to a specific area of the surveyed region, identifies the target and performs the intervention task. Among these phases, the vehicle surfaces and downloads all the collected data, which are interpreted by a human operator helped by a specialized interface to determine the localization of the target and plan the manoeuvring details of the second phase. RAUVI has been structured in three main areas, the vehicle, its control and navigation; the arm and its operation and the optical and acoustic perception services, which are under the responsibility of the UJI, the UdG and the UIB, respectively. The second year experiments, held at the Underwater Robotics Research Center (CIRS) in Girona, in March 2011, consisted in a Flight Data Recorder (FDR) recovery mission. A detailed description of RAUVI and a report of the whole experiment is out of the reach of this paper and can be found in [1] and [2]. Thus, here the attention is focused on the object recognition methods specifically developed to carry out the demonstration above-mentioned.

2. TARGET DETECTION

Generally speaking, visual object detection is split into two phases: A training phase in which a model of the object of interest is built from labelled images, and a detection phase where the trained model is applied to new images to determine the presence and location of the object of interest. Due to unpredictable underwater conditions, the appearance of the target of intervention cannot be known beforehand. Therefore, only the data gathered during the survey phase can be used to describe the target. The input data for the developed algorithm consists of one image, or a set of images, where the target is visible. On this image, the operator can determine the object of interest outlining it with a

polygon, as shown in Figure 1.



Fig. 1. Image taken by the AUV during the survey phase, labelled to train the system.

Using this data, a colour and shape model of the target is computed. A histogram of the Hue and Saturation channels of the HSV colour space is used to describe the colours of the labelled target. Choosing the HSV colour space and leaving out the V-channel makes the model invariant to brightness changes. As the scene is assumed to be static, a histogram of the background colours can also be computed and used to filter the target colour histogram, highly reducing false detection. This process results in a histogram containing only those colours that are significant for the target in the current scene. This histogram forms the colour model of the target. Moreover, the shape of the biggest area having these colours is stored as the shape model of the target. Figure 2 shows the colour and shape models for the FDR shown in figure 1.



Fig. 2. The model of the target consists in a histogram of significant colours (left) and a shape (right).

For the detection of the target in the intervention phase, the histogram of significant colours of the target is back projected on the current camera image. This marks each pixel with its probability belonging to the target. After applying a threshold to this probability image we can extract the contours of the found

shapes and compare them to the shape model we obtained in the training phase. The comparison is done in two steps. First the position and size of the candidate shape is normalized to fit the shape stored in our model. Then the candidate shape is rotated and the areas of intersection and union of the two shapes are computed. The ratio of intersection and union is used as measure for the quality of the match. The shape matching procedure returns the rotation with the highest score together with the position and scale parameters used for normalization. If all parameters lie in reasonable ranges and the shape matching score is greater than a given threshold the system reports the detection of the target, as shown in Figure 3. If the size of the object of interest is known and the camera is calibrated in relation to the robot arm, the information the presented algorithm provides suffices to perform an autonomous grabbing procedure.

3. CONCLUSION

A simple but efficient procedure for target detection is described that has been used to demonstrate the viability of a new Intervention AUV developed in the RAUVI project. Preliminary testing has been performed in a realistic but simplified scenario. In the near future, new experiments will be carried out in open sea conditions. Thus, more robust and reliable methods including texture and 3D information are under development.

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Fig. 3. Detection result. The target's position, orientation and scale are estimated.



Underwater life

THE CEAB'S MARINE OBSERVATORY IN THE CATALAN SEA: CONSOLIDATING LONG TIME SERIES OBSERVATIONS?

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Abstract – The Operational Observatory of the Catalan Sea (OOCs), created in 2009 at CEAB-CSIC may be considered as a reference marine observatory because of its effectiveness and relatively low-cost functioning and maintenance. The number of time series obtained at the observation station of the meteorological conditions above the sea surface, along with physical and biogeochemical properties of the water layer over the continental shelf, supports its success. The strong fluctuations of atmospheric conditions registered in the last years altering the marine conditions make the simultaneous records of meteorological and marine observations essential for understanding present environmental fluctuations and for improving marine environmental predictions. Updated information regarding the observatory can be found at <http://www.ceab.csic.es/~oceans/>.

Keywords – Marine observatory, operational oceanography, numerical modelling, ocean forecast, NW Mediterranean Sea.

1. INTRODUCTION

The Operational Observatory of the Catalan Sea started its activities in 2009 sponsored by a research project entitled "Observations, Analysis and Modelling of the Mediterranean Sea" (OAMMS), coordinated by A. Cruzado at Centre d'Estudis Avançats (CEAB-CSIC) and granted by the Spanish Ministry of Science and Innovation. The observing system consists of several components from observations to ecological modelling of the conditions in the Catalan Sea [1, 2]. An oceanographic buoy is moored at a permanent observation station in the Blanes canyon head. The buoy holds a number of meteorological and oceanographic sensors with data transmitted to a land station through data phone calls and published on near-real time in a dedicated web site (<http://www.ceab.csic.es/~oceans/>).

2. ACHIEVEMENTS

During roughly two years of activity of the observatory, several goals has been achieved and several activities remain in progress.

2.1 Observations

- Since Sep 2009, the underwater instrumentation provides 30-minutes interval data at surface, 25 and 50 m depth of chlorophylls, dissolved oxygen (DO), photosynthetic available radiation (PAR), turbidity, water temperature and salinity, and current velocity and direction. Atmospheric data at 2 m above the sea surface are PAR, air temperature, atmospheric pressure, wind velocity and direction, geographical coordinates.

- Since March 2009, regular cruises provide CTD and bottle data for chlorophylls, DO, inorganic nutrients, PAR, turbidity, and water temperature and salinity of the upper 200 m depth. Samples for picoplankton are taken since Feb 2010.

- SST and chlorophylls satellite images (AQUA-MODIS), as well as sea surface salinity (SSS) and wind stress in the study area have been processed in order to investigate for signals of atypical winter conditions [3, 4].

- Historical oceanographic cruises performed in Western Mediterranean are available to public through the NOAA website <http://www.nodc.noaa.gov/cgi-bin/search/prod/accessionsView.pl/details/44830>

- A standard Operation Procedure was implemented for all the activities related to the observatory.

2.2 Ecological Modelling

- A 3D model coupling the hydrodynamic and biogeochemical conditions of the Western Mediterranean Sea was implemented [4] with 1/20 degree horizontal resolution and 52 sigma-layers.

- A high space resolution 3D model simulating the conditions of the Blanes canyon head is under development [5]. The model is based on OPA (General MFS model with 1/16° resolution), nested into a regional POM with a 1/20° resolution and a coastal POM with 1/60° resolution.

- A one-dimensional vertically-resolved model simulating the hydrographic conditions of the observation station was implemented based on an earlier model [6].

2.3 Collaborative Actions

- The European Space Agency approved a proposal to perform validation/calibration activities of salinity data from the satellite SMOS.

- The OOCs is currently a part of the consortium MOON: Mediterranean Operational Oceanography Network.

- Comparison of microbiological characteristics in the observation station against coastal waters is being carried out in collaboration with members of the Institute of Marine Science (ICM-CSIC) members.

- Assessment of effective light transferring to primary and secondary producers is carried out in collaboration with ICM members.

- Review of cabled marine observatories activities has been performed together with ICM members.

2.4 Academic Activities

- The Fresenius University of Applied Sciences and Ludwig Maximilians University in Munich (Germany), through the Erasmus Program has provided Chemical Engineering students and biologists since 2009.

- The research and academic activities are published on the dedicated website (www.ceab.csic.es/~oceans). Open discussions are performed throughout the blog <http://groups.google.com/group/mars-i-oceans>

3. DRAWING THE PRESENT, SHAPING THE FUTURE

The relative simplicity of structure and components of the CEAB's marine observatory, working effectively with relatively low-cost operation and maintenance, make the observatory promising. Implementing an operational forecasting system for local sea conditions is pending. Faster application of quality control filters to data is in progress. The observatory's infrastructure is pending to be recognised as a permanent infrastructure at CEAB. Submitted national and international research projects supporting the observatory activities are pending for approval.

ACKNOWLEDGEMENTS

The marine observatory is supported by the Spanish Ministry of Science and Innovation project CTM2008-03983. The work team for field and lab activities has been integrated by Joan Puigdefabregas, Jordi Cateura, Gustavo Carreras, Daphne Donis, Gilberto Cardoso, Laura Navarro, Jan Schaefer and Carina Muller. Participation of private enterprises EMS, Eduardo Muñoz and Blanes Sub is acknowledged.

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WIRELESS COMMUNICATIONS FOR MARINE SENSOR NETWORKS

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Abstract – Current marine wireless communication systems used for monitoring applications based on buoys suffer from lots of weakness. Our research project concerns the design and development of new technological applications to improve marine communications. Particularly, a novel wireless sensor network based on WiMAX standard operating at the 5.8 GHz band (license-exempt band) is proposed. As an initial task, a propagation channel measurement campaign in maritime environments was carried out to investigate the impact of the wireless channel in different situations. This work provides radio measurements over sea around urban environments. In particular, a radio link between a buoy and a ship at 5.8 GHz is studied. LOS (Line-Of-Sight) and NLOS (Non-Line-Of-Sight) paths are investigated. The designed measurement system is described and the experimental measurements are shown. This investigation is useful, among others, for planning Worldwide Interoperability for Microwave Access (WiMAX) networks offshore around these challenge environments.

Keywords - propagation channel measurements, WiMAX, maritime environment, wireless sensor networks.

EXTENDED ABSTRACT.

Recently, many studies have identified an emerging demand for telecommunication services in several applications over sea. Some of them are getting great interest for the scientific community, e.g. those related to real-time monitoring through sensing multiple physical parameters from the sea. Although the number and kind of parameters depend on the specific application, monitoring systems are quite similar. Basically, these systems are based on a set of buoys and each one is equipped with two main subsystems. Firstly, a subsystem including a lot of sensor devices that measure locally the data. Secondly, a radio system which is in charge of transmitting them to a central base station for processing and monitoring purposes. The base station could be installed on shore or aboard a ship. This last case is particularly interesting for some applications, e.g. those related to oceanography campaigns.

Current wireless technologies used in this kind of applications are mainly based on VHF, cellular mobile telecommunication systems (GSM, UMTS, etc.) and satellite communications systems (INMARSAT, VSAT, etc.). However, these systems suffer from lots of weakness [1], like low bandwidth or capacity (GSM, Satellite and VHF systems), short range (cellular mobile telecommunication systems), high cost for certain applications (satellite and cellular mobile telecommunica-

tion systems) and the large size and weight of antennas and hardware transceivers (VHF systems). These limitations have motivated a new research activity. The general goal is to design and develop a novel broadband wireless communication system to perform applications like the one mentioned above.

A wireless sensor network based on WiMAX standard ([2], [3]) could be a good candidate to accomplish this task. WiMAX is an evolving technology that is optimized for operating on land environments where its good performance has been extensively demonstrated. Several frequency bands can be used for deploying this system. The license-exempt 5 GHz band is of interest to WiMAX because this is generally available worldwide and it is free for anyone to use, i.e. it could enable deployments in underserved markets, like the maritime one. In particular it is the upper 5.725 GHz-5.850 GHz band that is most attractive due to the fact that many countries allow higher power output compared to other bands. This facilitates less costly deployments. Regarding range and peak data rates, field tests on land have shown tens of kilometers and Mbps, respectively. These potential characteristics overcome the weakness described above. However, the performance of WiMAX networks in marine environments is not optimum due to the different radio propagation conditions. The main goal of a research project between the universities of Cadiz and Abdelmalek Essaâdi is to optimize the WiMAX standard for maritime applications.

An initial and crucial task for the optimization of this standard over sea is to study the radio propagation channel in these scenarios in the 5 GHz band. Particularly, buoy-to-ship propagation measurements were performed over sea. Fig. 1 shows the routes where the measurements were carried out.

Propagation models and measurements for land, both large-scale path loss and small scale multipath, have been discussed extensively. Further works in this field have been done in urban and suburban environments. Besides, although some works present experimental measurements of propagation characteristics for maritime radio links, they do not apply to conditions covered by our study. To the best of the authors' knowledge, buoy-to-ship links characteristics over sea at 5.8 GHz have not been investigated. In this work, we focus on LOS (Line-Of-Sight) and NLOS (Non-Line-Of-Sight) paths. We discuss them analyzing the measurements performed in a real marine scenario. This work is helpful, among others, to deploy WiMAX systems in these challenges scenarios.

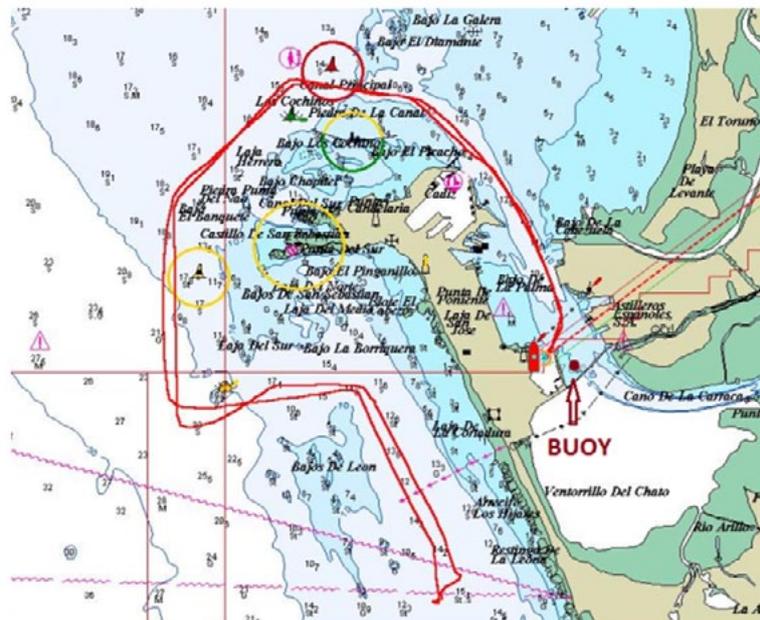


Fig. 1. Route followed by the ship (red) and fixed location of the buoy.

OCEAN DATA MANAGER: PRACTICAL SOFTWARE FOR OCEANOGRAPHIC SENSORS

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Abstract: Ocean Data Manager (ODM) is new free software designed in MATLAB. ODM has been developed to unify and process all data generated by a variety of oceanographic instruments. Specifically, it includes five different subprograms. This software has several applications to store, process and generate graphs from heterogeneous oceanographic data.

INTRODUCTION

Nowadays, a wide range of oceanographic instruments are available. Indeed, companies and institutions use multiple instruments (e.g. Conductivity-Temperature Profilers-CTD-, Acoustic Current Profilers-ACP-, flowmeters...) on a daily basis. Moreover, every institution and company have their own software to generate their own output files, resulting in a huge amount of files having different structures and formats.

For several years, the Institute of Marine Science of Andalucía (ICMAN-CSIC) has developed a piece of software able to unify all data coming from a variety of instruments. The name of this program is Ocean Data Manager (ODM) and it was created in MATLAB® (version 6.5).

OCEAN DATA MANAGER

ODM is a free software available at <http://www.icman.csic.es> together with the reference material [1]. This software has been designed in MATLAB, with a Graphical User Interface (GUI) which gives a more user-friendly component to the program itself. ODM presents a main screen where the links to the five subprograms are displayed. These subprograms may be used for the following actions: Import, Filter, Concatenate, Plot and Export, as shown in "Fig. 1".

Import

The import tool subprogram, which is the first module of ODM, provides the grounds for data format normalization. The subprogram has two important functions: the first deals with unifying the format file and the second with the creation of a Metadata (complementary information). It is necessary to build two MATLAB code programs, drivers, per instrument/sensor. Indeed, there are drivers for fifteen instruments although this number may be increased as each user can easily create these drivers using the guidelines described in the user's guide. After using this subprogram the user will work with .mat files.

Filter

This subprogram allows the user to remove easy-to-identify bad data. The main idea of this subprogram is to eliminate anomalous values that normally appear at the beginning and at the end of most data series. This usually happens when the user/scientist have to wait to stabilize the CTD into the water to perform a CTD cast or mooring while program and is anchorage at the beginning of the series and then when collected and discharged. These data are not deleted by the program, indeed it generates a filter to hide these data.

Concatenate

The task of this subprogram is to merge several files generated with the previous subprograms into a single file. Depending on the particular situation, being a campaign or a mooring sampling, the user will choose the appropriate button (Mooring Extend / Generate Campaign).

Plot

The plot tool provides direct graphical outputs in some common picture formats (JPEG, TIFF, PNG, etc.) as well as MATLAB figures. It is also possible to edit the final figure as it matches to the user's requirements and to export it to other standard graphical formats supported by MATLAB.

ODV Export

The ODV export tool transforms the information contained in a MATLAB data file generated after importing, filtering or concatenating, and generate as output a tab-separated ASCII file. Thanks to its internal structure this file can be plotted by more sophisticated third-party programs as Ocean Data View (ODV) created by Alfred Wegener Institute [2].

APPLICATIONS

ODM has been created to manage data files from multiples instruments. Moreover it easy generates and stores these files. At the same time, the user can take decisions in a small period of time observing the graphs or exporting data to other softwares. Two examples of this practical software are a temporal series and a CTD campaign data.

Temporal Series

One of the most important oceanographic series of data comes from moorings. Normally with this type of files it is usual to have anomalous data at the beginning and end of the series. ODM Filter removes the erroneous data. Furthermore, ODM Mooring Extend concatenates time series and generates a single file which makes the processing and plotting easier and faster.

CTD Campaign Data

Oceanographic campaigns sampling design is normally made up by several stations creating a grid. In each station the user generates a profile with a cast from the CTD instruments. ODM is a successful tool for this type of data because data can be processed directly during the campaign in a short period of time and pictures and reports easily generated. As in the case of time series, a single file may be generated, which can be successively treated with others programs to obtain graphics (eg, ODV graphs).

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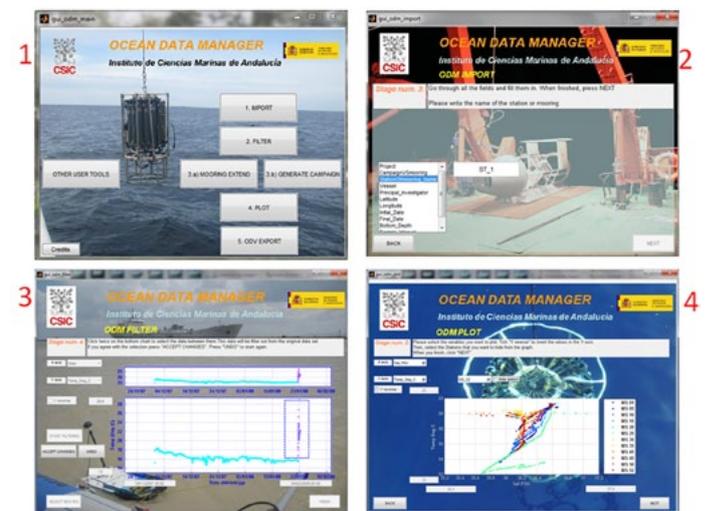


Fig 1. Several ODM screens. 1, ODM main screen . 2, ODM IMPORT. 3, ODM FILTER. 4, ODM PLOT

USE OF NEW SATELLITE IMAGES DEIMOS-1 TO STUDY THE GUADALQUIVIR RIVER PLUME

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Abstract- Estuarine environments are characterized by very complex morphodynamics and represent one of the most critical coastal regions for the exchange of sediment and nutrients. The fertilization of the continental shelf of the Gulf of Cadiz (SW Iberian Peninsula), in which the Guadalquivir and other rivers play an influential role, constitutes the major factor determining the productivity of the basin, from phytoplankton to fisheries resources as anchovy. Moreover, the input of nutrients and suspended particulate matter from the rivers has a relevant impact on several socio-economic strategic activities (aquaculture, tourism, navigation). The work presented here was undertaken to analyze the spatial variability of the Guadalquivir turbidity plume. The incorporation of DEIMOS-1 novel satellite images of high spatial resolution (around 20 m) will improve our ability to map turbidity and chlorophyll in the estuary and to assess and predict the plume behavior. To achieve this goal, remote sensing images from DEIMOS-1 satellite have been processed and validated against in-situ measurements from several cruises to check the quality and precision of satellite data in this coastal area. The high spatial resolution of these images will allow us to study spatial features related to the dynamics of the turbidity plume in the river mouth and connect these patterns with the meteorological and oceanographic process controlling it.

Keywords: Guadalquivir estuary; DEIMOS-1 images; chlorophyll; turbidity plume

The Gulf of Cadiz is a wide basin located on the SW coast of the Iberian Peninsula near to where the Atlantic Ocean connects to the Mediterranean Sea through the Strait of Gibraltar. The continental shelf receives substantial fluvial inputs associated with the discharge of major rivers such as the Guadiana, the Guadalquivir and the Tinto-Odiel [1]. The Guadalquivir estuary has undergone substantial rapid agricultural, fisheries, and anthropogenic development, particularly in recent decades. In spite of the social and economic importance, until very recently, only a few studies have been conducted on the zone [2 and references therein]. Water clarity and quality are important for the functioning of the ecosystems of the estuary and adjacent area, acting as an indicator of nutrient loading and sediment dynamics, and are critical variables for seagrass growth. Management strategies and methods that facilitate monitoring of estuaries are required.

Satellite-borne sensors technology is becoming an ideal tool for assessing turbidity and chlorophyll, thus enabling a more effective and reliable analysis of the temporal and spatial dynamics of plumes having the potential for improving our understanding of nearshore processes. The ocean color images of the

Guadalquivir estuary is affected by a variety of processes typical of environments with Case-II waters (i.e., the optical properties do not co-vary), including phytoplankton blooms, sediment plumes, and other episodic phenomena, such as runoff events [2, 3]. Each of these processes can individually modulate satellite-detectable signals contributing to the overall variability, especially in these waters which are characterized by a variety of seasonally-varying circulation patterns.

The aim of this study is to assess the potential of DEIMOS-1 remote sensing and bio-optical in-situ data for deriving water-quality parameters, and to develop an approach for successfully monitoring and predicting the turbidity as diagnostic tool in the coastal management of the Guadalquivir estuary. The DEIMOS-1 is the first private satellite in Europe which carry a multi-channel optical sensor. The satellite is an automatic spatial platform with a small size (only 100 kg weight) and very advanced technology that provides optic and infra-red images. It was conceived for obtaining Earth images with a good enough resolution to study the terrestrial vegetation cover, although with a great range of visual field in order to obtain those images with high temporal resolution. The sensor characteristics allow to achieve very high spatial resolution (20 m) and a wide field of view (600 km), hence it is suitable for coastal ocean color observation. During the last year, several DEIMOS-1 images have been captured over the Guadalquivir estuary. The high spatial resolution of these images will allow resolve the turbidity patterns than can be detected with this new satellite. Figure 1 shows two DEIMOS-1 images from the Guadalquivir estuary where the turbidity plume is located in the Guadalquivir river mouth. The intensity, size, orientation, location, etc of these plumes are different depending on the meteorological and oceanographic conditions (i.e. wind direction, tidal regime, waves, river discharge) that control the appearance and persistence of these plumes.

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Figure 1. RGB images captured from DEIMOS-1 satellite during 03/03/2011 and 12/16/2010 (left and right panel respectively).

TOWARDS A MARINE SDI: A METHODOLOGY TO ALLOW META-DATA INTEROPERABILITY

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Abstract: The INSPIRE Directive (2007/2/EC) is leading the way towards development and creation of a Marine Spatial Data Infrastructure (SDI) of the Institute of Marine Science (ICM-CSIC) and the Marine Technology Unit (UTM-CSIC). As a first step, a Catalog Web Service (CWS) was developed to access geospatial information of the projects, vessels and observatories, under the guidelines of standardization established by the Open Geospatial Consortium (OGC) and International Organization for Standardization (ISO). MIKADO was chosen to edit metadata and GeoNetwork to search, publish and distribute geospatial data across multiple catalogs. A specific Java app (called Forest) was developed to create metadata based on MIKADO XML files. Furthermore, an XML style sheet was developed to import metadata created by MIKADO into GeoNetwork complying with ISO 19139.

Keywords: INSPIRE, GeoNetwork, MIKADO, SDI, XSL.

I. INTRODUCTION

Until recently, oceanographic and geospatial communities have shaped reality differently. The former understands nature as equations with parameters and the latter as different geometries: polygons, points... that can be manipulated from a database. Today, SDI makes possible the convergence of acceptable standards to both communities that will enable the interoperability of applications for data management [1].

Recently, emergence of Google Maps and Google Earth has caused a geosciences revolution. These technologies have proven that all the geo-referenced information can be on the web. The INSPIRE European Directive and the Open Geospatial Consortium (OGC) have promoted the assumption of specifications and standards to go in that way.

This idea has been developed much more for the land context and nowadays, thousands of maps are served through Internet, with different land information layers. Marine SDI has been more difficult to develop because of its special characteristics of dimensionality (ex: 4D) or the need to view models (ex: evolution of 3D volumes over time).

Working with a metadata's standards is critical to ensure the interoperability over the data and to make possible data discovery, representation and retrieval. This project aims to improve the integration of existing technologies for metadata creation and exploitation.

Technical Committee 211 (ISO/TC211) [2] [3], within the International Organization for Standardization (ISO), determines the standards of ISO19100 family in relation with geo-referenced objects or phenomenon. In particular, it is responsible for establishing ISO19115 for geographic information metadata and ISO19139 for its relationship with application in XML schemas.

The development of a CWS was one of the first steps towards the Marine SDI done. It will allow to create a CWS, to search and browse metadata associated with information from the projects, vessels and observatories.

II. METHODOLOGY

A part of the project was to take into account the metadata generated during oceanographic cruises of BIO Hespérides and B/O Sarmiento de Gamboa, two

Singular Scientific and Technological Infrastructure managed by UTM-CSIC.

According to the needs, MIKADO [4] was chosen to create the metadata. IFREMER has developed this tool to generate metadata within SeaDataNet (2006-2010) of the EU Sixth Framework Programme. GeoNetwork [5] was chosen as a catalog application. This is a free and open source application that could manage geo-referenced resources complying open standards for services and protocols as a part of the Open Source Geospatial Foundation (OSGeo-OGC).

Using MIKADO it is possible to edit metadata in a simple way through a graphical interface with tabs and fields. In order to improve MIKADO features a Java application has been developed -Forest-, allowing quick metadata generation during an oceanographic cruise. The program uses templates which comes from MIKADO with common fields and edit the final metadata modifying only the variables (ID, date and coordinates).

MIKADO generates metadata in XML format, using its own metadata from SeaDataNet and others from ISO19115. However, the goal is to get a metadata complying ISO19100 family standards, specifically ISO19139 which could be imported to GeoNetwork. Integration between both tools is achieved using XSL technology. It is starting with 19115to19139 GeoNetwork style sheet which is modified to adapt it to the XML files from MIKADO.

III. CONCLUSION

A CWS has been developed and linked to the metadata creation during an oceanographic cruise. CWS allows to search, view and access to the cruise information. Thus, a pillar is established to the development of Marine SDI which will enable the oceanographic community in the geoscientific world on a level with others research branches.

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VERSATILE APPLICATION OF RFID TECHNOLOGY TO COMMERCIAL AND LABORATORY RESEARCH CONTEXTS: FRESH FISH SUPPLY-CHAIN AND BEHAVIOURAL TESTS

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*Abstract – RFID is an innovative information technology that allows the ability to attain massive amounts of data. It can be used for traceability of good through the different production stages as well as in behavioural sciences to identify different animals within a group. In this work we summarized two different sectors where this system could be developed. The first concerning the application of such technology to fresh fish supply chain, the second concern a laboratory application for the study of behaviour in laboratory held crustaceans of commercial importance (i.e. the Norway lobster, *Nephrops norvegicus*). The presented application of RFID to fresh fish supply chain consisted in the application of RFID tags along the fresh fish supply-chain of high commercial value. In the laboratory, a system of distributed architecture made by a microcosm tank with set of RFID controllers below it, each handling a group of seven readers in order to contemporarily portrait the behaviour of up to four individuals.*

*Keywords – RFID, fish supply chain, Laboratory applications, *Nephrops norvegicus*, Burrowing rhythms*

INTRODUCTION

RFID is an innovative ICT tool that allows the ability to attain massive amounts of data related to products, supplies, inventory, customer service, and machinery. Basic RFID system is composed by an antenna, an integrated circuit, a reader that gathers information from the id tag, and finally by a database system that is used to store the information gained through interrogating the id tag [1]. RFID technologies have gained significant interest from supply-chain industries and academics in recent years [2]. Tags advantage consists in its memory storage capacity, saving data in relation for example to the product identification number, price, cost, characteristics, manufacture date, location, and inventory on hand. The traceability of fresh food chain, such as the fish one has become crucial, challenging and important to keep fish product safety due to a high number of product variants, strict traceability requirements from the customer and the need for temperature control in the supply chain [32].

Marine RFID laboratory applications are scant for technical difficulties of propagating radio waves within the marine medium. Anyway, radio tracking devices can be used to quantify several traits of animals' behaviour, with potential application to marine organism of commercial interest.

Although the RFID is an ICT tool well developed, the potential applications of this technology are already to be investigated inside specific niche sectors in term of efficiency, efficacy and economic sustainability. In this context, we tested the RFID technology in two very different sectors: the fresh fish supply chain and the laboratory, with behavioural tests with groups of commercially important crustaceans (the Norway lobster, *Nephrops norvegicus*).

MATERIALS AND METHODS

The application of RFID technology was experimented on the fresh fish supply-chain. A total number of 8 fish (> 1.5 kg each) of 5 different species of elevate economic value (*Merluccius merluccius*, *Euthynnus alletteratus*, *Dentex dentex*, *Sparus aurata*, *Trigla lucerna*) was tagged on the operculum and followed along

the supply chain. The tags used was RFID HF 13,56 MhZ with unique identification data and rewritable memory. An encoding and inquiring unit for RFID tags (Psion Teklogix WorkAbout Pro G2) and a desk read/write unit (MB50) linked to a portable PC via USB was used. The information (time, place, species, additional information) linked to each single fish/tag was recorded along the supply-chain on the fishing boat, local fish market and fish shop.

Laboratory tests were conducted under 12-h light-darkness cycle (10 Lux) in a microcosm tank (150 x 70 x 30 cm) recreating the habitat medium of *Nephrops*. Four adults were tagged on their telson by a passive RFID transponder (13.56 MHz). A distributed system made by 6 controllers each receiving the signal of seven antennas was connected to a PC storing the spatial information on animals positioning by minute.

RESULTS AND DISCUSSION

The application of passive RFID tags on fish opercula evidenced the necessity to engineer a specific system to tag fish of large size in an easier and firm way. Along all the supply-chain, tags have been always readable; difficulties of reading were found in relation with the proximity of tags with readers. Information archival on a database resulted efficient and useful also for a potential evolution through a shared web-based system with all the supply-chain. The economic sustainability resulted positive only for fish with high commercial value raising also the satisfaction of both consumers and intermediate users.

We observed a variable nocturnal activity across days in the tested animals. Total activity varied over consecutive days. We also observed inter-individual differences in expressed overall activity. Those behavioural differences across-days in the same animal or among different animals within the same test group could be ascribed to the presence of strong territorial aggressive behaviour.

ACKNOWLEDGEMENTS

This work was funded by the projects "Sistemi innovativi per la tracciabilità della filiera ittica" (DM 2278 – 29/12/2006) from the Italian Ministry of Agricultural, Food and Forestry Politics and Laboratory developments were funded by the Spanish Ministry of Science and Innovation (MICINN; NORIT Project, CTM20055-02034/MAR). Dr. Jacopo Aguzzi is a Fellow of the Ramon y Cajal Scheme (MICINN). Part of this work is the result of the stage of Dr. Corrado Costa at the ICM-CSIC (Barcelona – Spain).

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EVALUATION OF A STATISTICAL PROCESS CONTROL (SPC) SYSTEM BASED IN A LOSSY COMPRESSION DATA ENCODING.

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Abstract - The aim of this research is to proof that data acquired on board, packed by Principal Components Analysis (PCA) and transmitted by satellite connection, are suitable for statistical process control, monitoring and predictive maintenance task. \bar{X} and s Chart statistical method will be used for monitoring, both, the original data and compressed data and the criteria for determinate if the process is in control or no, will be applied. Further, a comparative study using one dimensional variance analysis ANOVA is done between the original data and compressed data for determining if ($p \leq 0,05$) for process variables taken in a random way.

Keywords Principal Components Analysis (PCA), Statistical Process Control (SPC), Predictive Maintenance

INTRODUCTION

In this paper the suitability of a non-exact compressed data packets is discussed and it is used for implementing a monitoring system and for a statistical process control (SPC,) all that from the view point of reliability in a liquefied natural gas (LNG) ship.

The hypothesis of this study was to evaluate the reliability of a monitoring system using the theory of Principal Component Analysis (PCA) [1] to compress, with sufficient accuracy, the large amount of data being collected on board a ship and then send via satellite in a more economical or faster way than the traditional. We make an analysis of both data (the real data and non-exact compressed data) making the distribution of the average and the standard deviation establishing the control limits using (\bar{X} and s) chart [2]. Then we will see if these data collected on ground are sufficient to make telediagnosis and predictive maintenance decisions of the machinery on board using ground equipment [3]. Using these control charts we will initially identify whether the variables are in or out of control, by British or American conventions [2], so, significant cost and timesavings in telecommunications are obtained. The propulsion systems used today have more electronics systems, so a diagnosis on ground is becoming increasingly necessary.

The data used were collected on board a ship which transport liquefied natural gas LNG (Catalunya Spirit) through its integrated automation system (IAS, Norcontrol, Norway). This device generates a spreadsheet file every 1 hour, which represents the condition of 176 different variables signals of the major subsystems of the vessel, twenty four times every day, during nine days from february to april.

Non-exact compression is performed by applying the method of the PCA for monitoring the condition of the equipment on board, which allows a lower cost communication or reduce the occupation time of bandwidth for a given amount of data. A lossy compression technique includes a loss of information, where the exact original data cannot be recovered. So this compression is possible if some loss of fidelity is acceptable.

It is a way of identifying patterns in data, and expressing the data in such a way as to highlight their similarities and differences. Since patterns in data can be hard to find in data of high dimension, where the luxury of graphical representation is not available, PCA is a powerful tool for analysing data. The other main advantage of PCA is that once you have found these patterns in the data, is possible compress it, by reducing the number of dimensions, without much loss of information. In the modern process industry, PCA is widely used for SPC from datasets with large number of highly correlated variables recorded in real time by sensors located in continuous or batch processes.

The (\bar{X} and s) chart are the charts where the average is \bar{X} ; figure (1) and the standard deviation s , figure (2).

These graphics efficacy join the central tendency graph and the variability of the process graph.

The (\bar{X} and s) chart are use when the number of samples is very large. Using ANOVA method for compare populations, the result was that there were no significant differences ($p \leq 0,05$) using real data or using non-exact compression data and the interpretation of out of control using British conventions also did not differ significantly.

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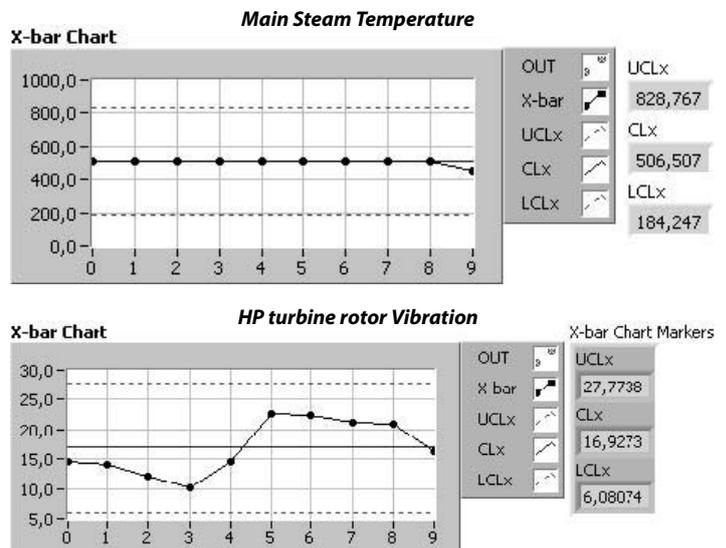


Fig 1.

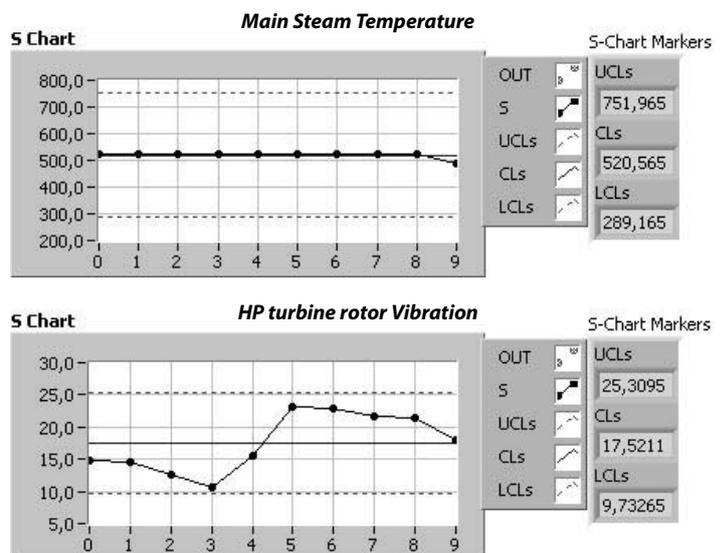


Fig 2.

IEEE 1451 HTTP SERVER IMPLEMENTATION FOR MARINE DATA

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Abstract- Accessing real time data from a marine sensor network (MSN) can be a challenge. Open access to real time data using interoperable internet technologies is one of the major demands. The IEEE 1451 Smart Transducer Interface Standards [1,2] specify a standard API (application processor interface) process to discover and access sensor data by using an HTTP connection. This paper presents an HTTP Server for Marine Data coming from OBSEA[3,5] cabled Observatory at the Western Mediterranean Sea. The implementation was using LabVIEW Web Services.

Keywords- IEEE1451, LabVIEW Web Services, Marine Sensor Network

INTRODUCTION

Data Interoperability is one of the major issues nowadays, where internet technologies enable the access to sensors data in real time. Sensor Web Enable (SWE) [4] from OGC (Open Geospatial Consortium) and IEEE1451 Standard are two approaches to achieve these interoperability problems. Discover and accessing available sensor data from an Internet web server through a standard is one objective of this work. In this case, an HTTP 1451.0 Server has been implemented using LabVIEW Web Services. Previous implementations of a HTTP 1451.0 server were done using different technologies or language programming like JAVA. In this case, LabVIEW graphical programming was used to facilitate the integration process for electronics or scientist who most times are more familiar with LabVIEW than other languages.

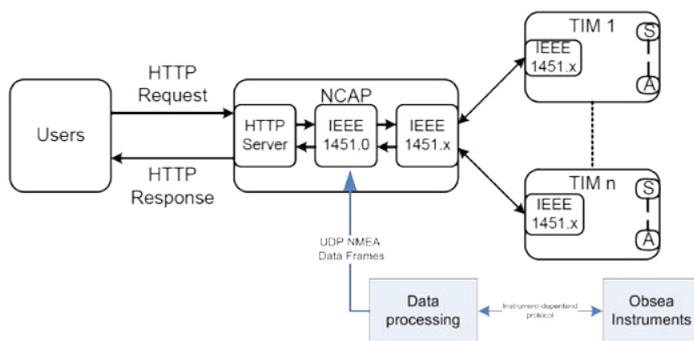


Figure 1. HTTP access to an IEEE 1451.0 NCAP and Non Standard Instruments Interface

IMPLEMENTATION

The IEEE 1451 family of standards were created to address the standard digital documenting of sensors [1,2]. The main objective is to add a digital layer of memory, functionality and communication to sensors so as to make sensors controllable and measurements accessible through a network with sufficient information on the sensor characteristics and history.

Figure 1 depicts the main components of a full compliance IEEE1451 system: The Transducer Interface Module (TIM), a device that could be either a sensor or an actuator with transducer channels and a Network Capable Applications Processors (NCAP) where different instruments or transducers are connected through a TIM (Transducer Interface Module). Each NCAP inside the system will have a NCAP address and each TIM connected to NCAP his TIM addresses.

For a non IEEE1451 compliance instruments, a data processing block implement the instrument manufacture-dependent protocol and translate the instrument data to a UDP NMEA-0183 style data frame that is sent to the IEEE1451.0 NCAP who interpret this data coming from a virtual TIM with virtual channels.

As an example, a non IEEE1451 instrument likes a marine CTD who measures current, temperature and depth will be interpreted by our NCAP as a virtual TIM with three different channels.

Some of the API commands implemented by the LabVIEW Web Service are shown in Table 1

A remote client use the "http" protocol to send messages to the IEEE 1451.0 NCAP, which acts like a server, serving transducer data to the remote client. The HTTP message from the remote client unit will be transmitted across a network connecting the remote client with the IEEE 1451.X transducer nodes, or in this case to the non IEEE1451 instruments. The message will adhere to the HTTP URL syntax (RFC 2616) as `http://<host>:<port>/<path>?<parameters>`.

Table 1. Implemented Commands by the LabVIEW HTTP 1451 web Service

•TimDiscovery (TimDiscoveryHTTPRequest, TimDiscoveryHTTPResponse)
•TransducerDiscovery (TransducerDiscoveryHTTPRequest, TransducerDiscoveryHTTPResponse)
•ReadTransducerData (ReadTransducerDataHTTPRequest, ReadTransducerDataHTTPResponse)
•ReadMetalDTEDS (ReadMetalDTEDSHTTRequest, ReadMetalDTEDSHTTResponse)
•ReadTIMGeoLocationTEDS(ReadTIMGeoLocationTEDSHTTRequest, ReadTIMGeoLocationTEDSHTTResponse)

For example: <http://esonet.epsevg.upc.es:1451/1451/Discovery/TIMDiscovery?ncapId=1&responseFormat=xml>

Where the NCAP server is hosted at esonet.epsevg.upc.edu at port 1451. The LabVIEW web service path for the discovery messages is /1451/Discovery and in this example a TIMDiscovery request to our NCAP is done asking for an xml formatted reply.

The LabVIEW IEEE1451 HTTP web service reply to the previous command will be

```
<TIMDiscoveryHTTPResponse xsi:schemaLocation="http://localhost/1451HTTAPI http://grouper.ieee.org/groups/1451/0/1451HTTAPI/TIMDiscoveryHTTPResponse.xsd">
<errorCode>0</errorCode>
<ncapId>1</ncapId>
<timIds>1,2</timIds>
</TIMDiscoveryHTTPResponse>
```

Where two TIMs with TimIds 1 and 2 are present in our system.

Our system is composed by one NCAP server implemented in LabVIEW as a 1451 Web Service and for the first test two TIMs who represents one CTD instrument with three and a meteorological Data Station with 40 channels

- CTD Instrument TIMid=1. Three Channels: conductivity, temperature and depth.

- Meteo Station TIMid=2. Forty Channels: *stationDate, stationTime, outsideTemp, wind10Avg, windDir, barometer, outsideHumidity, solarRad_uv, hiOutsideTemp, lowOutsideTemp, hiHumidity, lowHumidity, hiBarometer, lowBarometer, hiWindSpeed, hiSolarRad, hiUV, dailyRain, wind10Avg, hiMonthlyOutsideTemp, lowMonthlyOutsideTemp, hiMonthlyHumidity, lowMonthlyHumidity, hiMonthlyBarometer, lowMonthlyBarometer, hiMonthlyWindSpeed, hiMonthlySolarRad, hiMonthlyUV, monthlyRain, hiYearlyOutsideTemp, lowYearlyOutsideTemp, hiYearlyHumidity, lowYearlyHumidity, hiYearlyBarometer, lowYearlyBarometer, hiYearlyWindSpeed, hiYearlySolarRad, hiYearlyUV, totalRain*

CONCLUSION

In order to facilitate the interoperable access to the Obsea instruments data, a LabVIEW IEEE1451 HTTP web server has been developed. This development allow the OBSEA technicians to share instrument data through a standard interface easily and quickly.

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A SIMPLE METHOD TO PREDICT DIFFERENT FAILURE MODE OF SANDWICH COMPOSITE PANEL WITH HONEYCOMB CORE: APPLICATION TO MARINE STRUCTURE

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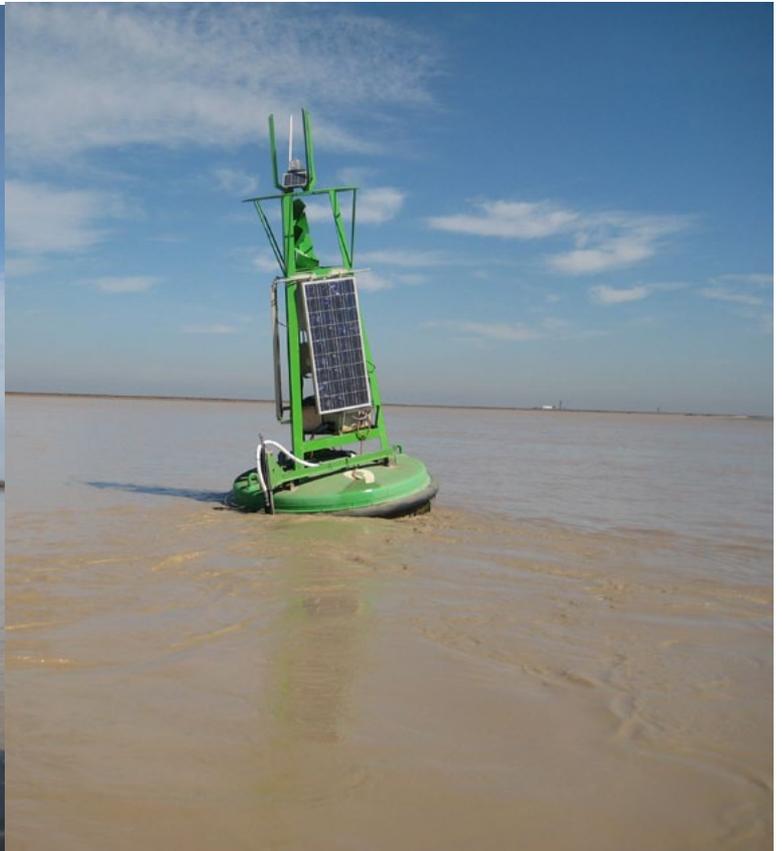
Marine, automotive and aerospace industries are continually trying to optimize material performance in terms of strength and weight. Success has been achieved through the growth of high performance materials including fibrous composites such as ceramics, new alloys, carbon fiber composites and through the use of structural concepts such as sandwich composite panel construction. Sandwich composite panel construction with honeycomb core consists of three components: two facing sheets, the core that fill the space between the facing sheet and the core-to-facing bonding adhesives. The facing sheets of a sandwich panel can be compared to the flanges of an I-beam element, as they carry the bending stresses to which the beam is subjected. With one facing sheet in compression, the other is in tension. Similarly the honeycomb core corresponds to the web of the I-beam that resists the shear loads and vertical compressive load to the face sheet. The core-to-skin adhesive rigidly joins the sandwich components and allows them to act as one unit with a high torsional and bending rigidity. Although the sandwich panels present a good strength to weight ratio and many other interesting mechanical characteristic and advantages, they have some disadvantages. Over the past 40 years, considerable work has been devoted to understanding these problems and trying to predict failure loads in damaged and undamaged panels accurately [2, 1]. This paper discusses the theoretical and quantitative design and analysis of a honeycomb panel sandwich structure. The initial design is based on specific requirements that the

panel must achieve prior to failure under load. Materials to be used for the facing and core are selected based on the given requirements. With the materials chosen, the facing sheets and core are analyzed for failure. Failure occurs when the stresses in the panel exceed the properties of the materials by any mode. The composite panel was modeled by a long beam under flexure test specimen as a simply supported beam loaded in pure bending.

In this paper, we present a simple model for prediction of different failure mode of face sheet and core material. The obtained results of this model were compared with experimental results [3] and present that it is a simple and good model.

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Multi-sensor Buoy in the Guadalquivir river (observation network of the Autoridad Portuaria de Sevilla)

NOVEL MATERIALS FOR MITIGATION OF DIATOM BIOFOULING ON MARINE SENSORS

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Abstract - Biofouling, the attachment and growth of organisms on hard surfaces, represents one of the main challenges to long-term autonomous deployment of marine sensors and sensor networks. Unmaintained or unprotected sensors rapidly experience data loss or drift unless some mechanism of biofouling prevention, or antifouling, is employed. In this paper, we present the results of our research into the basic mechanisms of marine biofouling, with particular emphasis on the surface factors that influence the attachment of benthic diatoms (Bacillariophyceae) in the early stages of the biofouling process. We present the results of our research into the influence of engineered surface topography (EST) on diatom adhesion and removal in the field, and demonstrate how careful control of surface topography and texture can be employed to produce novel means of mitigating diatom biofouling and thus increase sensor lifetimes. We demonstrate that surface topography feature spacing and orientation are vital cues for attaching diatoms, subject to species and attachment strategy. In addition, we present the results of our field trials of environmental monitoring sondes equipped with novel antifouling materials at Ireland's only statutory marine reserve, Lough Hyne. This interesting and dynamic site offers many challenges with regard to long-term sensor deployment due to biofouling.

Keywords - Biofouling, sensors, antifouling, topography, diatoms

1. INTRODUCTION

Biological growth and attachment to sensor components leads to costly maintenance and removal strategies and if these are not completed then data quality will be compromised. Traditionally, biofouling was prevented by the use of toxic broad action biocides such as tributyltin (TBT). However, since many of these compounds including TBT have been discovered to be environmentally damaging and have subsequently been banned in many areas of the globe, a need has arisen for the development of non-toxic alternatives. Fundamental to the development of these alternatives is an understanding of the physical and chemical parameters of substrate that is to be exposed, and the chemical and physical parameters that can be optimised for fouling reduction. Surface roughness and the topography nature of the surface or material are fundamental in this respect as they significantly influence the growth rates and attachment strength of marine organisms. In addition, careful control of the physical nature of the surface alters the chemical properties of that surface once immersed. Benthic diatoms (Bacillariophyceae) are an important component of marine biofilms and are commonly found as part of the biofouling community on environmental sensors. Additionally, these organisms passively contact a potential set-

ting surface and subsequently become motile and explore the surface before permanent colonisation. It is understood that surface crevices and niches provide protection from hydrodynamic shear forces and significantly affect surface adhesion and ecological community of attached diatoms. However no detailed results of field studies into the effects of carefully dimensioned engineered surface topography on diatoms have been published.

2. MATERIALS AND METHODS

A number of engineered surfaces have been produced in the elastomer, poly(dimethyl)siloxane (PDMSe) using photolithographic techniques. These surfaces exhibit a range of topographic patterns and feature spacing designed to test several of the common models developed for surface topographic inhibition of biofouling. Surfaces were exposed in the marine environment on environmental sensors for varying periods of time. Samples were then removed and preserved for analysis. Adhered cells were enumerated and identified using a combination of scanning electron microscopy (SEM) and light microscopy (LM).

3. RESULTS

Variation in the colonisation rates and species were seen on deployed engineered surfaces, implying that surface topography directly affects marine biofilm composition and subsequent biofouling community development (Fig. 1.). A relationship between species composition, based on cell size and adhesive mechanism, and surface topography type were observed. However strongest affects of surface topography were only seen in the initial stages of biofouling development, implying that other factors such as the settlement of a bacterial biofouling community and alteration of the topographic nature of the substrate subsequently reduce the influence of topographic patterning on diatom adhesion.

4. CONCLUSIONS

Carefully engineered surface topography influences the adhesion of marine diatoms in the natural environment and this in turn has implications for the development of novel non-toxic methods of biofouling prevention. Control of surface topography is vital in the development of new methods of biofouling prevention, and while creation of such topography on large surface areas may be economically unviable given current methods of topography production, there is significant scope for the application of surface topography to the improvement of the lifetimes of environmental sensors, given the smaller surface areas involved.

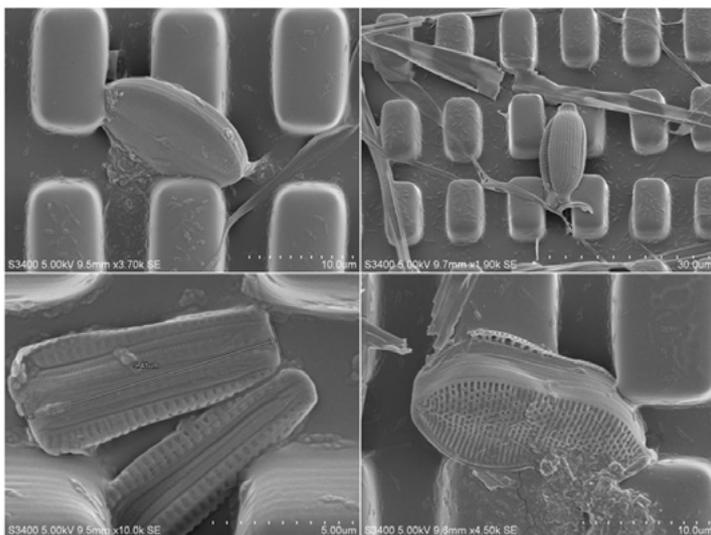


Fig. 1. Scanning electron micrographs of the adhesion of pennate diatom cells to surface topography created in PDMSe. Smaller cell types of a certain minimum size are unable to contact the surface completely and thus exhibit fewer focal adhesion points to the elastomer surface. This means that cells are easily removed and are less likely to undergo permanent adhesion to the surface.

UPGRADE OF THE OBSEA EXPANDABLE SEAFLOOR OBSERVATORY

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Abstract- The objective of this paper is to present the last modifications of the OBSEA observatory after the maintenance operations done.

Keywords- OBSEA, data publication, seafloor observatory, oceanographic buoy

INTRODUCTION

Since May 2011 OBSEA underwater observatory is providing data again, after an inactivity period caused for the electrical fault of the submarine cable. OBSEA (Expandable Seafloor Observatory) is a seafloor observatory located at 4km from the coast of "Vilanova i la Geltrú" (Barcelona, Spain) and at 20 meters depth. This station is connected to the shore station with and old telecommunications cable used to provide electrical power to and bring data from the observatory. At shore, a power supply is generating the 300Vdc required for the observatory and a bundle of servers are storing, processing and publishing all the data generated for the observation system.

DESCRIPTION

The seafloor node of OBSEA is equipped with a CTD (conductivity, temperature and depth), a Hydrophone and an underwater camera, moreover at land there is a meteorological station with temperature, pressure, wind and rain sensors. In addition, last may 2011 the observatory has been upgraded with a surface buoy with a weather station (Air Temperature, Ultrasonic anemometer, barometric pressure, magnetic compass heading, pitch and roll angles, rate of turn gyro, and GPS for position and speed) and with a surveillance camera. The buoy is connected to an Acoustic Wave and Current Profiler (AWAC) providing daily updated data of water movement.

Due to all these recent changes in the observatory, the OBSEA website has also been remodeled, in order to provide an easiest access to the obtained data.

Many data charts have been included (see fig. 1), so users can see the current status of the observatory in a quick look, and new functionalities have also been added. These include personalized queries, which allow users to obtain the exact data they want, or a more user-friendly interface for the live camera.

Two new live cameras have been included in the website too, related to new data sources: the surface buoy and a meteorological station located in the SARTI building. Besides from the video, these new sources provide new sets of data, which have also been added to the website, and will help to improve the user's knowledge about the observatory situation.

In the OBSEA project we are always thinking in the future for what in addition to the improvements that are being done at present several work lines are being planned to be developed next and following years. The next stage of the project will be the development of a second seafloor node in a near position with some features of deep water observatories. The new node will have a ROV mateable connectors plate usable for testing purposes of remote operated vehicles, will improve the energy management and efficiency and the monitoring and control capabilities. The structure of the observatory is also being designed to reduce the complexity and periodicity of the maintenance operations.

CONCLUSION

In this article last modifications have been presented and future actions to be done have been detailed.

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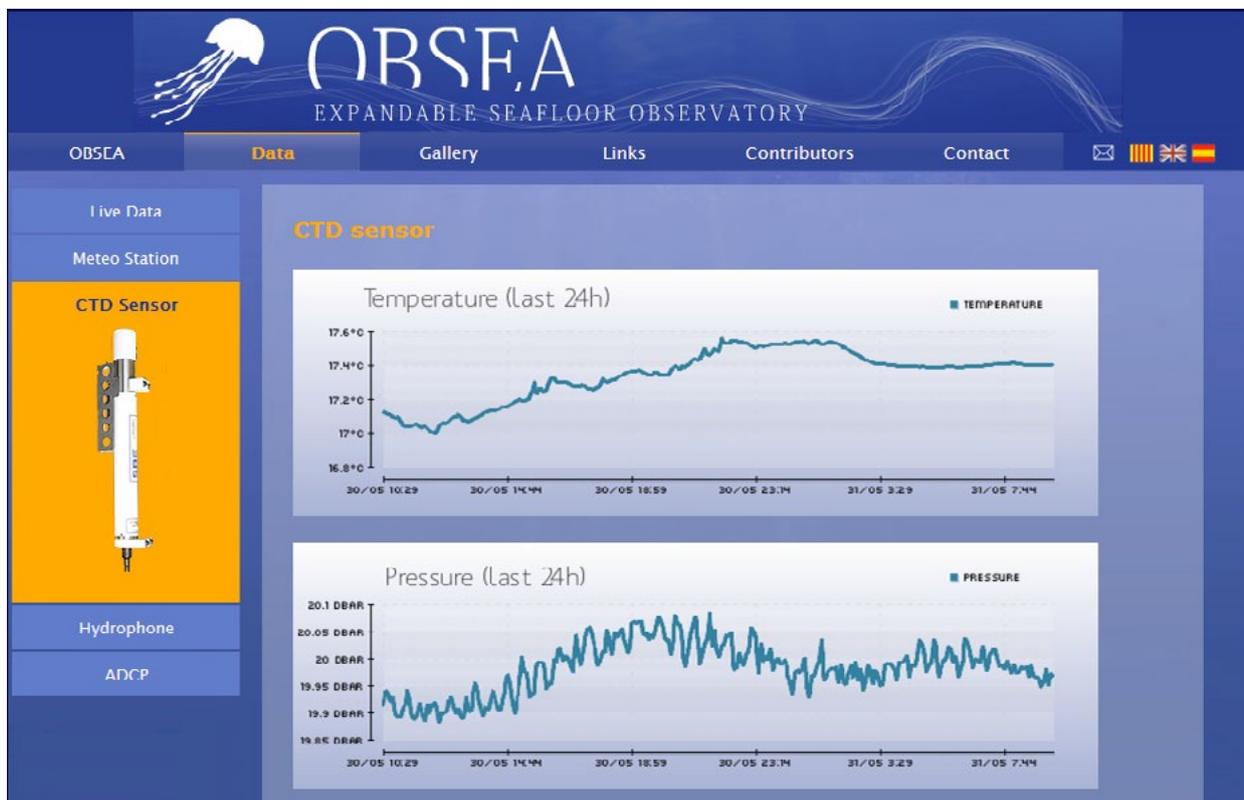


Figure 1: Data visualization in the OBSEA website.

MONITORING OF TUNA IN CAGES BY THE COMBINED USE OF ACOUSTIC AND OPTICAL TECHNIQUES.

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Abstract- In the frame of the European project SELFDOTT (From capture based to self-sustained aquaculture and domestication of bluefin tuna, *Thunnus thynnus*) an experimental setup to estimate the biomass of caged bluefin tuna (*Thunnus thynnus*) farms in the Spanish Mediterranean coast is presented. The aim is to monitor individuals during all stages of growth. To do this, we propose a combined system of acoustic and optical techniques (both non-intrusive), in order to obtain values of target strength of the specimens and information on the orientation of tuna in the acoustic beam and the fish size. To achieve a complete information, an experiment has been designed that allows us to get the acoustic measurements ventral and dorsal individuals accommodated in the cage (using in a first attempt a multiplexed echosounder with two 200KHz split-beam transducers), while stereoscopic systems provides visual information and allows estimate the size and weight of the specimens captured by the system. Preliminary results indicate that combined use of both techniques provides more precise values of the parameters needed to determine the TS as a function of fish orientation and for proper monitoring of tuna in floating cages.

Keywords- Bluefin tuna; acoustics; underwater; optical; Target Strength

INTRODUCTION.

In order to alleviate the pressure on the wild fishery of the bluefin tuna and aid in its conservation, the domestication of this fish and the development of a sustainable aquaculture industry are necessary. While the life cycle is being closed [1], efforts should be joined to design growth control mechanisms that make the process efficient and ecologically and economically sustainable for breeders.

With this aim, this work proposes an experimental setup that combines acoustic measurements (dorsal and ventral) with optical techniques, to obtain biometric information on a non-intrusive concept, allowing monitoring of weight gain of specimens and optimizing of resources management. This experiment was conceived as a first approach to the problem and rises the expectations open so far in [2] to obtain parameters showing the biometric behavior and state of the specimens in the aquaculture cages.

MATERIAL AND METHODS

The measurements were conducted in cages installed in the Mediterranean Spanish coast in El Gorguel (Cartagena). As stated above we disposed an acoustic and an optical system. The optical system (is a stereoscopic recording system) provides visual information of the specimens during measurement (behavior and orientation) as well as the length of the same. The acoustic system consists of two split-beam transducers of 200 kHz, and a multiplexer to operate them simultaneously with a scientific echosounder, governed by the same field computer than the optical system, therefore providing the necessary synchronization through the internal computer clock.

Acoustic and optical data are analyzed separately at first and then jointly. The processing of acoustic data is performed using software Sonar5_Pro [3]. This software allows us the identification of tuna traces in the echogram related to the image of fish crossing the acoustic beam.

Stereoscopic vision allows to determine biometric parameters of fish without handling them [4]. Several studies suggest that the use of these systems is useful for estimating the length and weight of specimens and thus to improve the efficiency in the breeding of this species in captivity [5]. The proposed experimental system is based in the alternate ventral measurement of images. For this reason, in this work a new procedure of image measurement are developed to estimate the tuna fork length, and validation of this new method for measuring image ventral in connection with the usual configuration of a stereoscopic system (lateral) is performed.

RESULTS

Data shows that the dorsal TS measurements offer a bimodal distribution, which can be explained by the detection of the main lobe and two lateral lobes of the swimbladder, crossing the acoustic beam, what has been described for other species [6]. Ventral data tend also to be unimodal, because the morphometry of the

swimbladder, more rounded than the dorsal side, reducing the directivity.

Another critical point to be taken into account is the relationship between the tuna and beam area size. For these reasons we have studied the dependence of the TS values with transducer distance. For the limited number of traces of this preliminary study, we can appreciate that mean ventral TS evolves with distance to an apparent stable value. Our dorsal data exhibit a more complex dependence with transducer distance than the ventral ones what can be related to the near field effects.

The acoustic results are crucial, to evaluate any TS versus size relationship based on biometric information obtained from optical equipment. From this information we can plot first ventral TS to length relationship for bluefin tuna. The mean TS of each traces is calculated and depicted for every measured length in the corresponding image. This must be considered just a methodological description but promising results are expected (Fig. 1).

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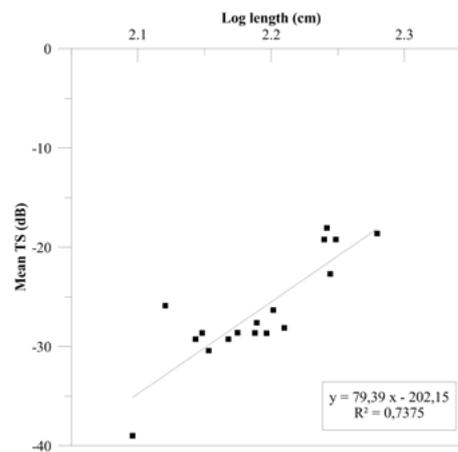


Fig.1. TS to fork length relationship

ACOUSTICAL GROWTH MONITORING OF GILTHEAD SEA BREAM (SPARUS AURATA) IN SEA CAGES

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Abstract – We show experimentally a linear dependence of target strength (TS) of gilthead sea bream, measured in sea cages, with the logarithm of the total length of fish. This relationship is obtained for the ventral aspect of TS of the gilt-head sea bream, measured by a low cost single-beam device. And it allows us to remotely monitor the growth of fish in sea cages.

Keywords - Target strength, Sparus aurata, sea cage, ventral aspect, physoclist.

1. INTRODUCTION

The aim of this study is to establish a relationship between target strength (TS) and total body length of the gilthead sea bream (*Sparus aurata*), which allows us to monitor their growth in sea cages. The estimated growth rate and biomass are crucial factors in the production plan and the management of marine farms. The gilthead sea bream is one of species of greatest economic interest in Mediterranean basin, and together with European sea bass (*Dicentrarchus labrax*) represent 95% of Spanish fish production.

2. MATERIALS AND METHODS

Five classes of commercial size gilthead sea bream are characterized from 20 to 25 cm (160 to 270 g). Firstly, we measure total length and mass of each of the specimens, previously anesthetized. Then a few specimens are introduced into a sea cage of 3 m in diameter and 2.7 high. We use two equipment to perform the acoustic measurements. We measure the TS directly using a Simrad EK60 echo sounder with a 7° split-beam transducer working at 200 kHz. Furthermore we use a low cost single-beam system, which allows us to record the full waveform with a high sampling rate, with a 30° single-beam transducer working at 200 kHz. Measurements are made for both ventral and dorsal aspect of fish, using both of measurement systems. The records are made with a transducer located in the center of the cage, at the bottom facing upwards for ventral measurements and on the surface facing down to perform dorsal measurements.

3. RESULTS

We perform two analysis based on single echo detection. The first examines all

available information concerning the amplitude and the arrival angle of echoes (split-beam analysis), obtaining absolute values of TS. While the second analysis omit the phase information (single-beam analysis), obtaining values of uncompensated TS (TSu). In the single-beam analysis we develop two algorithms, which differ in the order in which criteria are applied to detect single echoes.

TS distributions obtained from the split-beam analysis are unimodal for both ventral and dorsal measurements, like with the TSu when you apply first the threshold criterion. We found a lineal relationship between mean TS and logarithm of total body length of fish for the ventral aspect, which presents good correlations for both TS and TSu, even having a few detections. Note that the relationship between mean TSu and total body length allow us to monitor the growth of gilthead sea bream using a low cost single beam equipment. However the goodness of fit can be severely affected by noise and / or near-field errors.

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Fig. 1. Detail of mounting of the transducer at the bottom of the sea cage for the ventral measurement of TS on gilthead seabream.

BROADBAND CIRCULAR MICROSTRIP PATCH ANTENNA FOR WIMAX MARINE APPLICATION

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Abstract – The evolution of wireless communication systems have intended to exploit the research advance in telecommunications areas in order to get its performances. Actually, the microstrip patch antennas have more importance in radio communication applications due to its low cost and weight, ease of fabrication and installation. Particularly, in the sea environments, the motions of boys which are used as means for transmitting and receiving information can affect its communication services. To maintain this scenario of communication, an omnidirectional antenna is required. To meet the overall requirements, we have presented a slotted circular microstrip patch antenna. This antenna is fed by CPW structure to increase the frequency band. The antenna has a circular slot cut in the ground plane and circular patch is printed within that. Moreover, the WiMAX band 5.8 GHz is implemented in this application. The structure is designed on FR4 substrate by applying CST Microwave Studio simulation software.

Keywords – Wireless communication systems, Microstrip patch antennas, CPW structure, WiMAX.

INTRODUCTION

The wireless communications have evolved at surprising rate during the last decade, thus the transceiving antennas with simple structure are pressing in demand. Moreover, the future wireless communication systems require wideband antennas to ensure the transmission of high data rate and great information. In addition, the antenna design which meets the requirements of a simple structure and wide bandwidth for use in the modern wireless communication system becomes a challenge for the researchers.

Nowadays, microstrip patch antennas have been widely used in wireless communication systems due to its low profile, low cost, ease of integration and fabrication. However, this kind of antennas goes through some difficulties such as a low gain and bandwidth, directional radiation pattern. The recent researches in this line are adduced various techniques so that the microstrip antennas achieve its performance to be useful for manifold wireless communication applications. In the literature, many coplanar waveguide (CPW) fed and microstrip fed wide slot antennas have been proposed for wideband applications. The sea environment is one of the mediums in which the radio communication could use wide-

band antennas. Furthermore, the propagation of radio waves in this medium can be affected due to natural phenomena. The system boys used as means for transmitting and receiving information are equipped with radiant system or antenna which is considered as one of critic parts in the wireless communication systems. Moreover, the random motions of buoy necessities the specific properties of the antenna that can be used. In this sense, the small antennas size is required. To meet these specifications, the microstrip patch antenna is proposed. However, this kind of antennas has some limitations in which concern the radiation characteristics and impedance bandwidth. With the growth research on this subject, various techniques can be of interest to enhance the performance of such antennas. Otherwise, recent wireless technologies used in marine applications are mainly based on VHF, cellular communication systems and satellite communication systems. Whereas, these technologies in some cases suffer from lot of weakness like low system capacity, a short bandwidth, short range and limitation of frequency spectrum. These problems have taken into account new emergent technologies to fulfill these limitations. Therefore, the wireless system based on WiMAX standard could be a good solution for current wireless systems. This WiMAX can reach a theoretical up to 30 miles radius coverage. Moreover, the data rate concerned for the WiMAX band is 70 Mbps. These potentials characteristics tend to be adequate for our application case. Recent researches are focusing in the design of reconfigurable microstrip patch antennas for WiMAX technologies. This study is also based in designing microstrip patch antenna for working at the unlicensed WiMAX band 5.8 GHz in a marine environment. The structure includes a slotted circular patch antenna and is excited through the CPW fed technique. The design is printed on the substrate of the dielectric material FR4 having a dielectric permittivity and thickness. The simulation of the antenna is based on CST microwave Studio software. The simulation results are shown a good adaptation at the resonance frequency 5.8 GHz and good radiation characteristics of the antenna. The fabrication of the antenna will be made through the machine LPKF protoMAT S100, and the measurement results will be realized in next days by using HP 8722ES vector network analyzer and time-domain measurement system (Geozondas, Lithuania) to verify the simulation results obtained. The figure below shows the structure of the designed antenna.

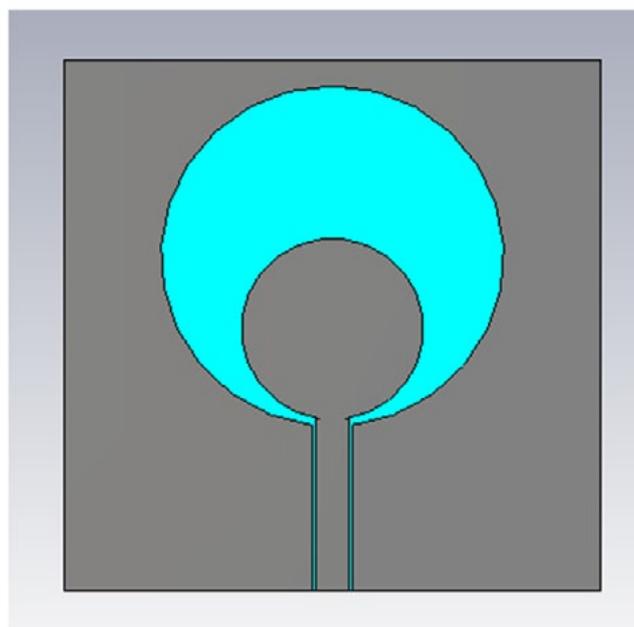


Fig.1. The structure of the designed antenna

POTENTIAL USE OF SPLIT-BEAM ECHOSOUNDER ANGULAR INFORMATION FOR BIVALVE BANKS CARTOGRAPHY: A CRITICAL EVALUATION

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INTRODUCTION

Acoustic methods have been recently used for the direct observation of mollusk reefs [1-3] providing information about their spatial distribution.

Among the current acoustic technologies are split-beam echosounders that detect phase differences, interpreted as athwartship and alongship angles [4], thus allowing the triangulation of point-like scatterers [5] or the assessment of the motion of a fish school [6]. These angular measurements over extended objects, such as the sea bottom, could be used to detect the inhomogeneities in the sediment.

The main objective of this study is to assess whether split-beam technology may provide information on the density of buried bivalve mollusks. Due to their differentiated shape (and thus, expected acoustic signature), we will focus our study in the mapping of razor shell banks.

MATERIALS AND METHODS

Study Area

The study was performed in the Ría de Pontevedra (Galicia, NW Spain). Three razor banks, regularly exploited by divers (they are located between 5-11 meters deep), were considered for this study: Raxó, Agnete and A Cova. Attending to their razor harvesting density at the time of the survey, these banks were characterized as very productive (Raxó), productive (Agnete), or non productive (A Cova).

Acoustic Survey

Fourteen acoustic transects parallel to the coast were recorded along the banks. A Simrad EK60 scientific echosounder with an ES200-7C split-beam transducer was attached to the hull rail of a small fishing boat. The transducer was set to work at 200 kHz and minimum pulse length (64 μ s) and at a sampling frequency of 10 pings/s. Weather conditions were good and the boat speed was kept between 2.5 and 4.2 knots.

Groundtruthing

In order to validate the acoustic classification, 2 stations were set per bank. Sediment samples were collected with a 30 cm corer, and biological communities were characterized using a suction pump with a mesh size of 1 cm. All these data were found to be in agreement with fishermen harvesting information.

Split-beam Texture Analysis

A second order statistical procedure, aimed at detecting correlations between nearby acoustic samples, is textural analysis based on the symmetric co-occurrence matrix [7], usually defined along a given direction of the data matrix: we will take this direction along the pings of the angular echogram. Haralick [8] introduced a set of textural features that (together with lacunarity) have been calculated for the first 30 cm of sediment signal for each transect of the survey.

Statistical Analysis

A hierarchical agglomerative cluster analysis was performed on the transects to classify them by banks. To account for the spatial distribution a further classification was performed dividing the transects in four segments each. To reduce the dimensionality, prior to clustering, PCA analysis was performed, keeping only those components with eigenvalues larger than 1 (Kaiser's rule). Furthermore, all the statistical treatment was repeated twice considering only transects and segments leaving the coast to portboard or starboard, respectively.

The pitch and roll motions of the vessel were not mechanically compensated during the survey. To address the influence of these motions on the result, two kinematic variables, the speed and the pitch and roll motion amplitude (inferred from the reflected intensity variance) were computed around each ping. Then

the same statistical analysis (PCA and hierarchical clustering) was applied to these data, in order to highlight any resemblances to the angular classification.

RESULTS AND DISCUSSION

The statistical analysis of the transects, based on textural features, results in a dendrogram showing three main branches, one formed by two Raxó transects and the other two further subdivided in two subbranches, one corresponding to Agnete, and the others to Raxó and A Cova. When the course is taken into account, the coast-to-starboard dendrogram groups all the transects by banks. The dendrogram of the textural features of the segments shows four main branches: Raxó, Agnete, A Cova, and the remaining one further divides in four sub-branches two with Agnete and the other two with Raxó and A Cova. Again, separation by courses, improves the grouping of the segments by banks.

The two halves of the Agnete bank are differently grouped. The other two banks, do not show this spatial segregation. This is in accordance with the ground-truthing data of razor density. Neither the distribution of the segments comprised in the branches mixing different banks, nor the distance between neighbour branches can be explained by granulometric data or razor densities alone. The dendrogram obtained from the kinematic variables mostly separates the three banks, as did the angular textures, a result that cannot be achieved using one single kinematic variable. However, the classification has more "misplaced" segments, and lacks any hint of inhomogeneity in Agnete.

CONCLUSIONS

This work has shown that split-beam echosounder angular signal provides information about the sediment characteristics that can render a seafloor classification. However kinematic variables have been shown to be correlated with part of that information too.

In this sense, the compensation of the ship motion at acquisition time is imperative in order to make the most of the acoustic angular data, even when weather conditions are good and vessel speed is kept almost constant.

ACKNOWLEDGEMENTS

The authors acknowledge the financial support of the European Regional Development Fund (ERDF) and wish to thank Fismare Innovación para la Sostenibilidad, S.L. for their collaboration in the acoustic data gathering campaign.

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HYBRID SAILBOAT: PROPULSION MODELLING AND ENERGY GENERATION POSSIBILITIES

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Abstract - This paper shows the modelling and energy generation results obtained during sailing with a hybrid ship in the generation phase. A normalized course and wind condition was settled. The different vessel components were mathematically modelled: hull, propeller and interaction between them. Several simulations were performed sailing to evaluate available power to use in energy generation, optimal propeller operation set point, ship speed variations, generated energy at different thruster speeds with every apparent wind angle. Sailing with 15 kt wind speed, the maximum generated energy was 0.924 kWh in 8.1 nautical miles. The ship speed reduction was 11 %. The maximum available power was 909 W. The propeller speed control can improve the generated energy. Presented energy recovery strategy, helps to reduce hybrid sailboat fuel consumption and emissions, compromising navigation speed about 10 %.

Keywords Control system, Hybrid, Modelling, Sailboat.

INTRODUCTION

A hybrid ship is a vehicle which can use, for propulsion purpose, two or more methods of energy storage: hydrocarbon, electric storage battery, hydrogen, inertial wheel, supercapacitors and so on. Really, one or several internal combustion engines (ICE) are coupled to electric generators and/or shaft propeller, using tank fuel energy. In addition, it is possible to use the storage energy in electric batteries by electric motors to rotate the propeller/thruster. Sometimes it is able to recover and storage the waste kinetic energy from stopping manoeuvres or when she is navigating under sail. Further, that energy will be used in propulsion or manoeuvring.

This paper shows the modelling and energy generation results obtained during sailing with a hybrid ship in the generation phase. Our reference ship was the University of the Basque Country training ship "Saltillo". A normalized course and wind condition was settled. The different vessel components were mathematically modelled: hull, propeller and interaction between them. Several simulations were performed sailing to evaluate available power to use in energy generation, optimal propeller operation set point, ship speed variations, generated energy at different thruster speeds at different wind angles.

OBJETIVES

The aims of the work were:

- To establish a normalized course and wind condition to compare different generation strategies in the same scenario.
- To model mathematically the different vessel components: hull, propeller and interaction between them. Integrate all components by software for feed-forward simulations.
- To evaluate available power to use in energy generation
- To calculate optimal propeller operation set point
- To determine ship speed variations due energy generation.
- To compute generated energy at different thruster speeds with every apparent wind angle.

RESULTS

Several simulations were performed to calculate the available power to generate energy with the propeller versus its rpm for different sailing conditions (Figure 6). A negative power value means energy flow from propeller to propulsion plant. The considered wind speed was 15 kt in all cases. Sailing between WP1-WP2 represent the condition close ridged 60° to true wind and the best generation situation was achieved at 112 rpm with $P_{min} = -375$ W. Sailing beam reached (90°) to true wind (WP2-WP3) the best state of energy generation was $P_{min} = -590$ W at 124 rpm. Finally, was evaluated sailing broad reached (150°) to true wind with $P_{min} = -909$ W at 151 rpm.

After the best propeller operations points were calculated for each ship sailing direction, another set of simulations were performed over WP1, WP2 and WP3. For this sailing course was calculated total generating energy, ship speed, propeller thrust and hull required thrust. When the ship is arriving to WP1, just mechanical propulsion was used (section 1 in figure 7). The propeller thrust was equal to hull required thrust and the ship speed was constant. In section 2 only sail propulsion was used and propeller speed was adjusted to 112 rpm, being the propeller thrust negative. The available power to use in energy generation was -375 W in the axle of the prime mover and the vessel speed was 4.49 kt. Between WP2 and WP3 the wind thrust increase, the propeller set point was 124 rpm and achieved ship speed of 5.22 Kt. In section numbered as 4, the ship had the highest wind thrust, the propeller rpm was adjusted to 151 rpm, getting speed of 6,07 kt with -909 W. For each device of the ship energy chain, i.e., prime mover, power electronics, batteries, etc, efficiencies would be applied to get final energy storage.

The differences in ship speed (kt) between sailing with zero propulsion thrust and sailing with energy generation in best rpm set point are represented in the figure 8. The speed reduction was regarding 10-11 %.

The maximum available energy for the proposed wind speed and course was 0.924 kWh over 8.1 nautical miles using previously calculated propeller optimum speed set points. For other thruster speeds, the obtained energy was less, being not much significant until 10 % rpm variation.

CONCLUSIONS

As conclusion of the presented work can be say that the proposed experimental course and wind condition were very useful to compare different generation strategies in the same scenario. The mathematical model of sailboat based on integrated model approach architecture is a powerful tool to reduce developing time in the hybrid sailboat design. The available power to use in energy generation is significant and useful to energy generation, incremented in longer tracks sailing under sail exclusively. This power was highly dependent of the propeller rpm operation set point. An advanced control algorithm is necessary to maximize energy generation. The ship speed variations due energy generation were significant, about 10 %. Presented energy recovery strategy, helps to reduce hybrid sailboat fuel consumption and emissions, without compromise navigation speed. The positive results obtained from these simulations will be continued capturing navigational data by means of instrumentation already installed on board training ship "Saltillo". Tests at sea are going to be carried out on 2011.

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MONITORING SPECIES IN ARTIFICIAL REEFS USING ACOUSTIC COMMUNICATIONS

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Abstract- on this work, the performance, configuration and limitations in the field of an acoustic communication system to monitor marine species in artificial reefs has been studied and analyzed. The system described is composed by different hydrophones and acoustic transponders.

Keywords- hydrophones, acoustic communications, monitoring species, species tracking

I. INTRODUCTION

Advances on electronic technologies applied to marine applications have found new possibilities with the increasing offer of new miniaturized sensor and new types of wireless communications systems, which have opened a door to a new generation of distributed smart sensor networks, spatially or geographically disseminated in the environment. This is particularly interesting on these days, when 76 % of global fisheries stocks are currently over-exploited or exhausted and with risk of extinction if they are not managed correctly [1]. In order to help to prevent this, an adequate fishery management is imperative; therefore there is the need to increase the actual knowledge of the habits of the exploited species. This paper is a contribution to previous works [2-4] in which different technologies and designs were presented, developed, and tested to monitor and to study the behavior of species. These techniques were developed for their use in laboratories or small aquariums, and present many drawbacks when are used in the field. The strength of acoustic communications technology respect the previous works is the cost and maintenance of the system versus the detection area covered, this is shown in Table 1.

II. OBJECTIVES AND DESCRIPTION

The objective of this work is to study and analyze the performance and configurations of the hydrophones and the transmitters in artificial reefs, where interference problems are present due to the echoes of acoustic signals [5]. The results from this work will be used in a future experimental campaign with green shell crabs (*Carcinus maenas*), which has the purpose to investigate living habits.

The monitoring system is composed by three transmitters and four hydrophones, located inside and outside two artificial reefs, close to the OBSEA underwater observatory [6], which is located at a depth of 20m. The different experiments - location of the transmitters and hydrophones - make possible this study.

The underwater system is based on Vemco's commercial equipments. The transmitter is the model "V6", which operates at 180 kHz. This frequency operates well in both fresh and salt water, in a range of up to 200m. The most interesting features of these kinds of transmitters are their size and weight (6mm of diameter and a weight of 0.5 grams in water), in addition to the possibility to program the latency of the emitting signal, which can be from some seconds to minutes. This feature allows extending the active life of the transmitter when the experiment requires long periods of time (up to one year sending pings every several minutes). The hydrophones are the autonomous Vemco VR2W-180.

III. EXPERIMENTS AND RESULTS

The system described has a maximum detection range of 200 m. The location of transponders and hydrophones will influence this range as well as the presence of interferences in the medium. In our case, it will be severely affected by the signal reflections on the artificial reefs, which are concrete cubes of 2.5x2.5x2.5 m. In order to test the system, a set of three transmitters and four hydrophones

have been placed inside and outside the artificial reefs in two experiments, each with a particular function, as shown in the Figure 1.

On the first experiment, the detection range of transponder 2 is evaluated by hydrophones C and D. This set-up shows the high interferences caused by the artificial reef 1. In this case, C is able to detect sometimes the tag 2, meanwhile D is out of range. In this configuration, the mission of tag 3 is to check if hydrophones A, C and D are working well because all of them are inside the range. The location of tag 3 also permits to contrast the performance of detections

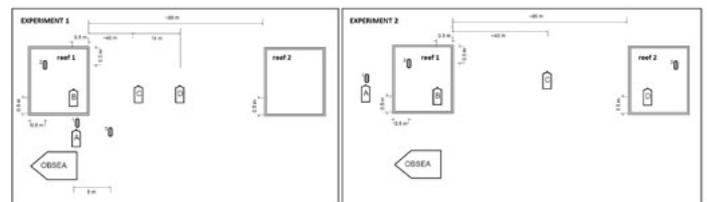


Fig. 1. Experiments performed

considering the interferences by the reef

On the second experiment, the distribution of some transmitters and hydrophones has changed. Here, receptions of hydrophones B and D is tested, in order to evaluate detections of the external transmitters. On this case, Hydrophones A and C are used to contrast the detections from outside the reefs. The distance between reefs is enough to inhibit the acoustic signals from transmitters inside others reefs.

Results of different tests confirm also that the position of hydrophones inside closed areas is critical, and in order to improve the reception performance it is advisable to place them as far as possible of the reef walls. These results will be used on a experimental campaign for monitoring species in the OBSEA area.

ACKNOWLEDGMENTS

We want to acknowledge the financial support of the Ministerio de Ciencia y Educación of Spain, through the project "Sistemas Inalámbricos para la Extensión de Observatorios Submarinos" CTM2010-15459 (subprograma MAR). Jacopo Aguzzi is a Fellow of the Ramon y Cajal Scheme (MICINN).

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Features	IR barriers	RFID	Vision	Acoustic comm.
Transponder or ID attach to the specie	No	Yes	Yes	Yes
Cost Vs. detection area covered	Medium	Very High	Medium/high	Low
Maintenance	High	High	Medium/ low	Very low
Detection of multiple individuals	No	Yes	Yes	Yes
Transponder battery life	-	unlimited	-	limited
Detection highly affected by the environment	Yes	No	Yes	No

Table 1. Technologies comparison to monitor species

TECHNICAL ADVANCES IN NEAR REAL TIME SEAFLOOR MONITORING IMPLEMENTED FOR THE MOMAR-D PROJECT

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Abstract - After a description of the near-real time monitoring infrastructure implemented on the Lucky Strike hydrothermal field, at a depth of 1700 m offshore the Azores, this paper presents the recent technical advances that made this experiment successful. The technical results obtained to date are presented.

Keywords - Deep-sea observatory, Long term near real time monitoring, Experimental feedback.

INTRODUCTION

The MoMAR-D (Monitoring the Mid-Atlantic Ridge – Demonstration mission) project is one of the six missions selected by ESONET NoE* to demonstrate its partners' capability of implementing and operating long term marine observatories, from their design to their exploitation phases. The MoMAR observatory focuses on seafloor geological, chemical and biological processes occurring on the Mid-Atlantic ridge on the Lucky Strike vent field, located 200 nautical miles offshore the Azores at a depth of ~ 1700 m.

EXPERIMENT

The observatory was installed in October 2010 during the MoMARSAT cruise (see presentation by Sarradin et al.) and since then transmits, four times per day, observations from the seafloor to an onshore data-base. The infrastructure is complemented with different autonomous sensors throughout and around the vent field. Initially, the expected duration of the monitoring experiment was twelve months. The marine data acquisition and transmission infrastructure will be described, with an emphasis placed on the recent technical advances and key choices that made this experiment successful.

The marine infrastructure consists of two Sea Monitoring Nodes (SEAMON) located on the sea floor, each serving a set of local sensors, and a surface buoy (BOREL). The role of this buoy is to relay the transmission to shore, via satellite, of the acoustically received seafloor measurement data. The two SEAMON nodes benefit from the same architecture. They provide their sensors with the means to record and transmit their measurements for one year: energy, measurement sequencing, local data storage, data transmission to the servicing submersible, remote data transmission, and protection against bio-fouling.

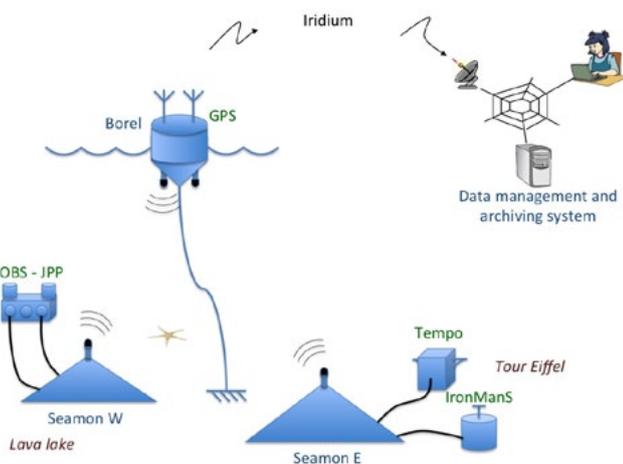


Fig. 1. General sketch of the near-real time monitoring system

SEAMON West is dedicated to geophysical monitoring and installed on the western edge of the Lucky Strike lava lake. It serves an instrument package developed by the Institut de Physique du Globe de Paris that combines a permanent pressure gauge and an ocean bottom seismometer. The geophysical

sensor frame was lowered to the seafloor separately from SEAMON West, then electrically connected to it with an innovative underwater connecting device

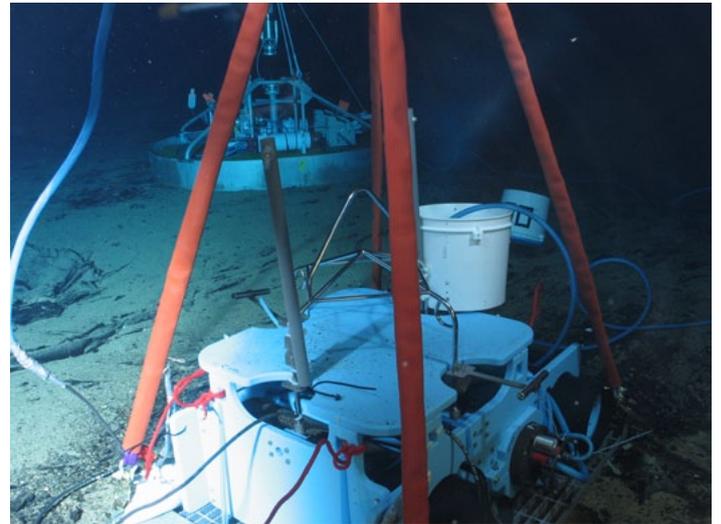


Fig. 2. The geophysical node © Ifremer - Victor - MoMARSat 2010

operated by the ROV Victor 6000.

On the other hand, SEAMON East was installed at the base of the 11 m active Tour Eiffel edifice, 600 m to the East of its sister SEAMON West. This node is dedicated to studying the links between faunal dynamics and physico-chemical factors. Seamon East is composed of a newly developed high definition video camera with associated Light Emitting Diodes, an Aanderaa optode (dissolved oxygen) and two in situ chemical analysers. All the sensors were fitted on two daughter frames installed on the SEAMON chassis and electrically connected to it on the ship deck. The frames were extracted from the node by Victor 6000 after the whole module was lowered to the seafloor. We report the successful first time use of an underwater Wifi data link between the HD camera and the submersible, allowing real time in situ video streaming used to tune the camera from the surface control room.

Carefully installed within acoustic range of the two SEAMONs on the ocean surface, the BOREL relay buoy comprises two independent and redundant communication channels, each composed of a newly developed acoustic modem (Evolgics GmbH, Germany) selected for its high energy efficiency, a local management unit and an Iridium modem (NAL Research Corporation, USA). The use of Iridium RUDICS (Router-Based Unrestricted Digital Interworking Connectivity Solution) service, associated to a specific data protocol allows efficient satellite transmission of a large amount of data, including a daily digital image. In addition to transmitting the periodic data flow from the sea bottom to the shore, the buoy allows the instant transmission of alarms from the seafloor and the modification from shore of the functioning parameters of the various observatory components.

RESULTS

The technical results obtained at the date of the session (during and after the installation cruise) will be presented and discussed.

ACKNOWLEDGEMENTS

This work is partly funded by the European Network of Excellence FP6-ESONET (PI R. Person, Ifremer, grant agreement 36851) and the European FP7-HERMIONE Collaborative Project (PI P. Weaver, grant agreement 226354).

THE IMPORTANCE OF MULTI-PARAMETRIC ANALYSIS IN LONG-TERM SUBMARINE GAS EMISSION MONITORING: THE SN4 OBSERVATORY AT THE NORTH ANATOLIAN FAULT (MARMARA SEA, TURKEY)

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Keywords: seafloor observatory methane seepage multi-parametric

Methane-rich fluid vents have been widely observed and associated to active faults in the Sea of Marmara, along the submerged portion of the North Anatolian Fault (NAF). Episodic gas seepage also occurs in the Izmit Gulf, along the NAF segment that ruptured during the 1999 Izmit earthquake. This site is thus a unique area to test the hypothesis on the relation between strike-slip deformation, seismic activity and gas expulsion within an active fault zone. A long-term multi-parametric experiment can be an effective way to study the irregular dynamics of gas emission from seafloor and to understand its possible relation with seismic activity.

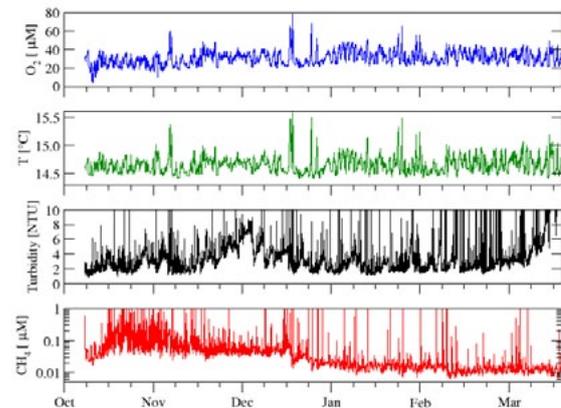
A benthic seafloor observatory (SN-4) was deployed in the Izmit Gulf in 2009 using the R/V Urania as a demonstration mission in the framework of the EC ES-ONET (European Seas Observatory NETwork) project. Instrumental redundancy and specific cross-correlation of data from different sensors, proves to be fundamental to distinguish actual seepage events from other signals related to oceanographic behaviour or even sensor biases. The observatory was equipped with a three component broad-band seismometer, a CTD with turbidity meter, two methane detectors, an oxygen sensor and a current-meter. All sensors installed on the observatory were managed by dedicated low-power electronics, which can manage a wide set of data streams with quite different sampling rates. A unique reference time, set by a central high-precision clock, is used to tag each datum. After six months of continuous monitoring, SN-4 was recovered in March 2010 in order to download the data and replace the batteries for a further six month mission period and finally recovered in October 2010.

The data analysis clearly shows frequent degassing events, recorded as methane anomalies in seawater and as high-frequency short-duration signals recorded by the seismometer. The time series of other oceanographic parameters (temperature, oxygen concentration, turbidity and salinity) shows patterns that seem to be linked to both local gas seepage and to the circulation of water masses in the Gulf of Izmit. A comparative analysis of the various observables and their mutual correlation, can be a key tool to understand actual degassing events along the NAF. This analysis is first attempt in finding possible correlations between seismic activity and gas release with a significant confidence level.



Fig. 1 The SN-4 seafloor observatory

(below) Fig. 2 Six month time series, from October 2009 to March 2010; from bottom to top: methane (log. scale), turbidity, temperature and oxygen concentration.



OPTIMIZATION STUDY OF A FLUORIMETRIC SENSOR FOR DETERMINATION OF DISSOLVED OXYGEN IN SALINE AND NO-SALINE WATER, BASED ON THE TiO₂-PHOTOCATALYTIC OXIDATION OF 2-ACETYL-PYRIDINE PICOLINOYL-HYDRAZONE

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Abstract – A fluorimetric sensor has been developed for determination of dissolved oxygen in natural waters. The sensor is based on the photooxidation of 2-acetylpyridine picolinoylhydrazone (APPH) using oxygen and TiO₂ as the catalyst. Firstly, the reaction mechanism has been studied. Secondly, an instrumental system for the determination of oxygen dissolved in water has been developed. Finally, the results obtained were validated by comparison with the Clark method.

Keywords – Oxygen, seawater, photocatalyst, fluorimetric, sensor

INTRODUCTION

Oxygen concentration is closely related to many important chemical and biochemical reactions. Optical sensors have been developed as an alternative approach for O₂ sensing. Several complexes with O₂-sensitive fluorescence characteristics have been used for the development of oxygen sensors measuring their fluorescence intensity or lifetime. Usually these optical oxygen sensors are based on collisional quenching by molecular oxygen of a fluorophore embedded in a support matrix [1].

The photocatalytic oxidation of organic compounds in water has received much attention and TiO₂ is used as a heterogeneous photocatalyst for this purpose. TiO₂ is photoactive in the UV region (<400 nm) and is currently considered the most promising catalyst for air and water photocatalytic decontamination. Water and oxygen molecules are considered necessary for the photooxidation process. For aqueous TiO₂ suspension system, it is believed that the *OH radicals from hole-trapping by surface hydroxyl groups are the primary oxidizing agents, and oxygen is a scavenger for photogenerated electrons [2].

TiO₂-APPH SENSOR AND DISSOLVED OXYGEN DETERMINATION

A. Nature of the reaction

In the present study, an analytical methodology is developed to quantitatively determine the dissolved oxygen (DO) involved in the process of photooxidation of 2-acetylpyridine picolinoylhydrazone (APPH), using TiO₂ as the catalyst. The reaction yields a fluorescent product which is read at 445 nm with excitation at 365 nm. APPH was prepared by condensation of equimolar amounts of acetylpyridine and picolinoylhydrazide in absolute ethanol. The white product was filtered and recrystallized from ethanol [3]. APPH forms coloured systems with V(V), Ni(II), Co(II), Fe(II, III). Only the reaction with Ti(IV) gives rise to a fluorimetric system.

All attempts to find a stoichiometric relationship between Ti(IV) and APPH failed, because the fluorescence is not due to the formation of a chelate. Further experiments have shown that aerial oxidation of the APPH occurs being catalysed by Ti(IV); in the photooxidation, oxygen acts an acceptor of photogen-

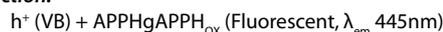
erated electrons. The proposed mechanism of the catalytic reaction is:

Photocatalytic activation:

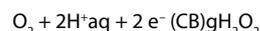


where h⁺(VB) and e⁻(CB) are a hole in the valence band and a photogenerated electron in the conduction band, respectively.

Oxidation reaction:



Reduction reaction:



B. Preparation of the sensor and oxygen analysis

Before starting the calibration to determine the concentration of oxygen dissolved in water samples, the fluorimetric sensor is activated. Figure 1 shows the automatic system designed to activate the sensor and to carry out the analytical determinations. In first place, a small volume (100-300 µl) of a 40% aqueous-ethanolic solution of APPH 0.017% (w/v) and Ti (IV) 50 ppbv is injected through the solid phase of the sensor (C-18 and cationic resin). Subsequently, it is applied Milli-Q water deaerated with nitrogen, and Milli-Q water saturated with oxygen, in order to obtain the instrumental zero (fluorescence 0.0) and the fluorescent intensity equivalent to 100% oxygen saturation, respectively. Once it is obtained the corresponding regression line (fluorescence versus % dissolved oxygen), fluorescence of samples is measured using the instrumental system described. Samples and standards are pumped at a constant flow (1-3 ml/min). Preliminary results show that the proposed method exhibits good correlation with the reference method of Clark with low relative errors. Thus, at 20 °C and 1 atm of pressure, the relative errors for 10, 30, 50, 70 and 90% oxygen saturation were: -4, -0.33, -1.6, -0.71 and 0.8%, respectively (regression line: I_f = 0,0923 [DO] - 0,136; R² = 0,9992).

Further experiments will be carried out using other solid phases in order to optimize the stability of the fluorimetric system and to improve the immobilization of the APPH-TiO₂ system with the aim of analysing a greater number of samples after the sensor activation.

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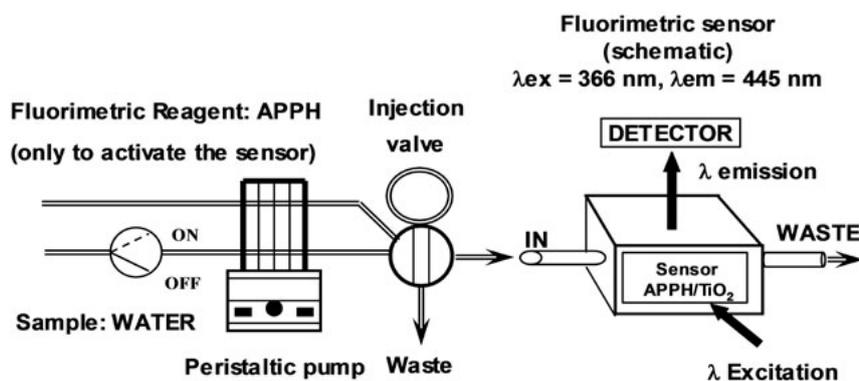


Figure 1. Manifold for continuous determination of dissolved oxygen in natural water using the proposed fluorimetric sensor.

UNDERWATER OPTICAL MAPPING

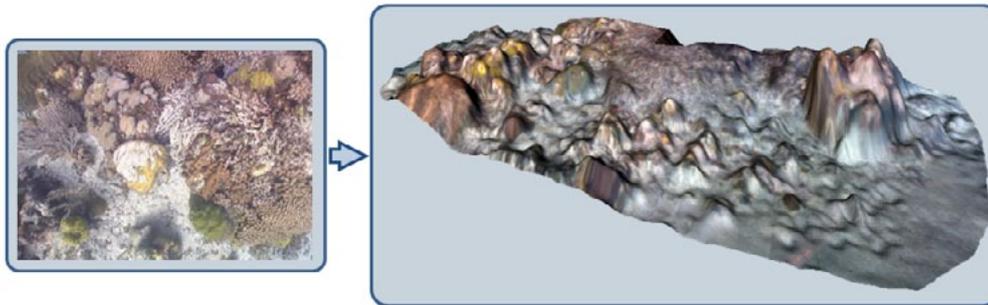
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Robot navigation and mapping has greatly advanced in the last few years as a tool for environmental monitoring and seafloor characterization. Seafloor imagery is routinely acquired during near-bottom mapping surveys conducted with both remotely operated vehicles (ROVs) and autonomous underwater vehicles (AUVs). Deep-sea hydrothermal fields or shallow-water coral reef communities are, for instance, two scenarios that have long been the target of such studies. Imagery is useful to characterize the nature and distribution of geological features and biological communities, extract ecological indicators, and to provide a permanent visual record of the seafloor condition. However, imaging studies often yield large numbers of images (several tens of thousands, especially in deep-sea cruises) that are frequently underutilized largely because of the difficulties inherent in processing and visualizing large data sets. Moreover, light suffers from a rapid and nonlinear attenuation underwater that affects the acquired images.

In this paper we will describe ongoing work at the University of Girona towards

development and application of vision-based seafloor survey methodologies, including large area 2D mosaicing (>1sqkm), monocular-based 3D mosaicing, and stereo seafloor modeling. The developed tools set a first step towards detecting and documenting the temporal variations associated with the active processes operating at these sites.

We will also illustrate the result of blending composite mosaics into a seamless high-resolution picture of the seafloor to provide a meaningful representation of the seafloor. Light attenuation, suspended particles (producing light scattering), strong parallax and frequent moving elements are typical in underwater imagery. Therefore, conventional blending techniques used in terrestrial imagery are not always adequate in the underwater context. Finally, we also present an approach to create accurate three-dimensional textured models of the seafloor using monocular video sequences. The method takes into account the geometry of the scene through a 3D vertex selection mechanism which results in a reduction in the complexity of the final 3D model, with minimal loss of precision.



SUBMARINE ACTIVITIES OF THE ROYAL NAVAL OBSERVATORY

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The Eurasian-African plate boundary crosses the called "Ibero-Maghrebian" region from the San Vicente Cape (SW Portugal) to Tunisia including the south Iberia, Alboran Sea, and northern of Morocco and Algeria. The low convergence rate at this plate boundary produces a continuous moderate seismic activity of low magnitude and shallow depth, where the occurrence of large earthquakes is separated by long time intervals. In this region, there are also intermediate and very deep earthquakes. In this area there are several seismic networks deployed, as for example the WM BB network. But, due to the fact of that many events are located at marine areas and the poor geographic azimuthal coverage at some zones provided by land stations, earthquakes parameters (location, depth,...) are poorly determined. To solve these problems, two ROA initiatives have been funded by the Spanish "Ministerio de Educación y Ciencia": The ALBO project (RIOA05-23-002) and the FOMAR net project (CGL2005-24194-E), both of them supported by Spanish Navy.

The ALBO project aims to install a permanent ocean bottom observatory in the surroundings of the Alboran island. This submarine observatory was installed about 1800 meters away from the island on the ocean bottom, with a 46 meters depth, and linked to the surface by a fiber optic submarine cable. The surface

equipments, installed on land, collect all data and transmit them to ROA by Navy intranet facilities and by satellite. In the submarine part several instruments have been deployed: a broad band seismic sensor (CMG-3T BB) and a pressure gauge are integrated in the Gúralp system, but also a current meter will be installed in the future. Also, several TCP-IP connections and power are available for future additionally instruments. Complementary on the island, a permanent geodetic GPS station and a meteorological station are installed. The Alboran island is declared as a Natural Park and also as an underwater reserve, so authorizations for the installation was needed from several autonomic and national institutions.

The FOMAR net project consists to deploy three long term temporal OBS's at the Gulf of Cádiz and Alborán sea. The OBS's were manufactured in KUM Laboratories with a BB seismic sensor (CMG-40T), an Hydrophone (HTI-04-PCA/ULF) and a KUM compass for orientation, and the recorder is a GEOLON-MCS (manufactured by SEND). All system is contained in titanium pressure tubes including batteries. First deployment was carried out past April.

The actual situation of both projects is shown in this work.

PRELIMINARY U ISOTOPIC DATA IN THE CÁDIZ COASTAL AREA (SW SPAIN) AS PROXY FOR COASTAL GROUNDWATER DISCHARGE

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Abstract - Sampling was performed at points in the Bay of Cádiz in order to obtain activity ratio $^{234}\text{U}/^{238}\text{U}$ and the concentration of U in each of the sampling points. These samples were analyzed through ICP-MS (Inductively Coupled Plasma Mass Spectrometry) [1]. The results indicate that many of the activity ratios are very close to the seawater ratio. The U concentrations are very similar to those expected for average seawater, though some stations are evident lower.

Keywords: ICP-MS, $^{234}\text{U}/^{238}\text{U}$ activity ratios, coastal aquifers, SGD.

INTRODUCTION

Recently there has been a growing interest in knowing the concentration of various radionuclides that can affect directly human health [2]. There are few studies of this kind in the area of the Bay of Cádiz, SW of Spain. Therefore, we feel necessary to study and establish existing levels of U and $^{234}\text{U}/^{238}\text{U}$ activity ratios in water from wells in this area. From this, in a future work, we will also characterize submarine groundwater discharge (SGD) in this zone [3].

MATERIALS & METHODS

Several seawater and groundwater samples (500 mL) have been taken with the aim of estimating the $^{234}\text{U}/^{238}\text{U}$ activity ratios and U concentrations in Cadiz coastal zone.

By ICP-MS techniques a solution of U prepared from modern coral (exhibiting a seawater ratio of 1.148 ± 0.002) was used as a control to correct for the observed mass discrimination. Three blanks (composed of deionized water) were prepared and analyzed along with the samples. The analyses of these blanks reveal no significant contribution in either the activity ratio or the concentration data though appropriate blank subtractions.

RESULTS AND DISCUSSION

Given that the accepted $\text{AR}_{234/238}$ value for seawater is 1.148 ± 0.002 and the one- σ uncertainties in U concentrations are conservatively estimated as $\pm 0.05 \mu\text{g/L}$, the detection limit for determination of U in water by this procedure (after 100x dilution) is about $0.02 \mu\text{g/L}$.

Obtained results indicate that many of the activity ratios are very close to the seawater ratio. The range of obtained values ranged from 1.135 ± 0.015 to 1.336 ± 0.030 . In the case of wells present in coastal aquifers, it has been found that are apparently exhibiting ratios slightly higher than seawater, though this could be clarified with more precise data.

CONCLUSIONS

The U concentrations are very similar to those expected for average seawater, though in wells closest to the coast are evident lower.

There is some evidence of the existence of submarine groundwater discharge (SGD) based on the hydrologic input-output balance performed in the area by the Spanish Geological Survey.

Future work include the comparison of the obtained results with radio isotopes data and re-performing these measurements with greater precision making a new laboratory protocol and interpret these data against the general objectives of the seawater – groundwater mixing research.

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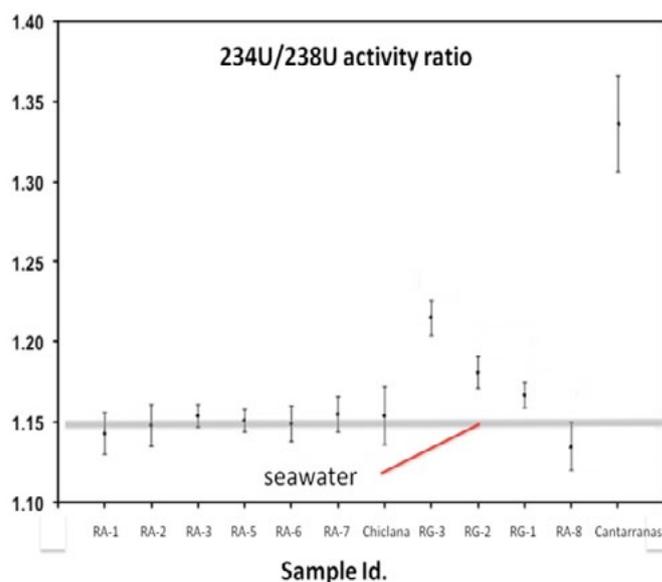
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Table 1. $\text{AR}_{234/238}$ and U concentrations for each of the sampling stations

Sample Id.	$\text{AR}_{234/238}$ *	U ($\mu\text{g/L}$)**
1	1.143 ± 0.013	3.34
2	1.148 ± 0.013	3.36
3	1.149 ± 0.010	3.37
17	1.158 ± 0.003	3.39
4	1.151 ± 0.007	3.38
5	1.149 ± 0.011	3.39
6	1.155 ± 0.011	3.52
7	1.154 ± 0.018	1.10
8	1.215 ± 0.013	2.17
18	1.216 ± 0.009	2.28
9	1.181 ± 0.010	2.91
10	1.167 ± 0.008	3.23
11	1.135 ± 0.015	3.45
12	1.336 ± 0.030	1.22

*The accepted $\text{AR}_{234/238}$ value for seawater is 1.148 ± 0.002 .

**The one- σ uncertainties in U concentrations are conservatively estimated as $\pm 0.05 \mu\text{g/L}$. The detection limit for determination of U in water by this procedure (after 100x dilution) is about $0.02 \mu\text{g/L}$.



UNCERTAINTY ANALYSIS OF ENVIRONMENTAL LOADS RESPONSE FOR FIXED OFFSHORE PLATFORM IN CLIMATE CHANGE CONDITION

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Abstract – Face to the increasing tendency of extreme sea hazards' intensity and disasters' losses, this paper proposes an uncertainty analysis method for fixed offshore platform response. The multivariate compound extreme value distribution model and uncertainty analysis are used to predict the extreme sea state and deck elevation. Compared with API and DNV recommended practice, the prediction sufficiently demonstrates the new method's rationality and security.

Keywords –Climate Change; Global Uncertainty Analysis; Multivariate Compound Extreme Value Distribution

In 2005, Hurricane Katrina and Rita triggered disastrous damage to New Orleans, and resulted in hundreds of destroyed and damaged platforms. Face to the increasing tendency of extreme sea hazards' intensity and disasters' losses, the lesson from 2005 disasters showed that some ambiguous definitions recommended by API and DNV must be taken into account.

In this paper, the combined effect of climate change induced extreme sea hazards and global uncertainty analysis of environments in offshore platform design are studied and some design code calibration are made as follows.

1. Typhoon/hurricane induced sea hazards such as wave, wind, surge, current combined design loads are the most important factors for platform stability, reliability and deck elevation. Due to the complexity and randomness of sea hazards, the data series have to involved the different kinds of uncertainties: method-model uncertainty; data sampling uncertainty; statistical uncertainty[1]. The different coefficient variation of uncertainties COV and confidence intervals can be obtained of statistical analysis.

2. The Global Uncertainty Analysis (GUA), Global Sensitivity Analysis (GSA)[2] as main tools can be used for input sea environments with uncertainties and corresponding sensitivity of structure responses. Through the forward-feedback process for input-output with uncertainty- sensitivity analysis, the more reasonable responses can be obtained. (See Fig.1)

3. Multivariate Compound Extreme Value Distribution (MCEVD) was firstly published in US ASCE journal as Compound Extreme Value Distribution (CEVD)[3] and 1982 used for long term prediction of hurricane characteristics along Gulf of Mexico and Atlantic coasts[4]. Since 2005 hurricane Katrina and Rita disasters proved accuracy of 1982 predicted hurricane characteristics and after disaster calculated results by MCEVD[5,6,7], it stands to reason that MCEVD is a practicable model for prediction of typhoon/hurricane/ tropical cyclone induced extreme events. In this paper the MCEVD with GUA, GSA and the effects of global climate change (sea level rise and typhoon/hurricane increasing tendency)[8,9] is used to calculate the extreme sea environments responses and deck elevation of jack-up platform in South China sea .

4. Comparing different design loads standards, this paper gives four definitions about the design extreme loads (See below), takes a Jacket platform with 30m design depth of water as example, and analyzes the maximum structural stress and deformation with different design standards.

(1) Traditional Design Method: 100-yr. return period wave height combined with associated wind and current.

(2) Single Factor Method: 100-yr. return period wave height combined with 100-yr. return period wind speed and 100-yr. return period current speed

(3) MCEVD design method: MCEVD considers the correlation among the factors and takes the simultaneous wave, wind and current as design criteria, so it can give the real "100-year" sea state.

(4) GUA design method: Based on MCEVD: 100-year sea state is defined by taking account of the influence of climate change and other uncertainty factors.

5. Comparison between our proposed method and API, DNV and china design code recommended method[10,11] shows: The result by our method is more reasonable(See Table 1,2) and it also can be proved by 2005 Gulf of Mexico some damaged platforms [12].

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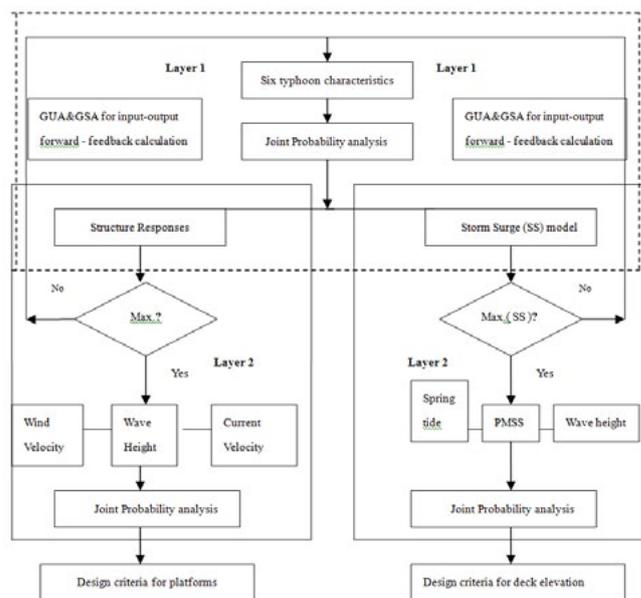


Fig.1. Application of GUA and GSA to defense code calibration

Table 1. Comparison of calculated results by different definitions

	Wave (m)	Wind (m/s)	Current (m/s)	Phase angle	Max DOF (m)	Max Stress (MPa)	Joint Return period (yr)
1	8.63	39.90	1.24	58°	0.3088	0.118e9	150
2	8.63	56.04	2.37	58°	0.5146	0.194e9	500
3	6.91	45.86	1.50	58°	0.2355	0.927e8	100
4	8.72	45.86	1.50	58°	0.3507	0.133e9	180

Table 2. Comparison of calculated results by traditional addition method and MCEVD

Traditional addition method	H _s (m)	Crest height with 100 return period yrs (m)	Surge with 100 return period yrs (m)	Tide & Air gap(m)	Deck elevation above LAT(m)
	5.53	3.69	1.85	2.45+1.5	9.49
MCEVD method	Joint probability of 100-yea return period				
	H _s (m)	Crest height (m)	Surge (m)		
	5.18	6.22	0.61		10.78
MCEVD (GUA)	6.53	7.84	0.61		12.40

MULTI-SENSING NODE ARCHITECTURE FOR WATER QUALITY MONITORING

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Abstract- This work presents a multi-sensing node architecture designed and implemented for water quality assessment. The sensing channels of each measurement node include temperature, conductivity and turbidity measuring data. Particular design of the sensing devices, software implementation on the base station, as so as the periodic calibration of the sensors followed by upgrading of voltage to water quality conversion algorithms, through the data stored on a SDcard, assures high measurement accuracy. Using a 2X RS232 to Ethernet converter and a Ethernet bridge, the data from the WQ measurement node and the node localization, delivered by a GPS unit, is wirelessly transmitted to a base station. Embedded software was developed for the PIC18F4520 microcontroller using the MPLAB C Compiler for 18MCU Microchip implements data acquisition, SD card data reading, primary processing, and data communication. Additional LabVIEW software implemented on the base station level includes data communication, data logging and graphical representation of the WQ data from selected monitoring nodes.

Keywords: water quality monitoring, embedded systems, conductivity, turbidity, temperature

INTRODUCTION

Water is essential to human life and health, as well, to ecosystem preservation. Water quality (WQ) is commonly defined by its physical, chemical, biological and aesthetic (appearance and smell) characteristics [1].

To perform water quality assessment, different parameters are measured using field measuring systems with multi-channel sensing capabilities such Quanta Hydrolab and Seabird SBE 25 that are expensive equipments with proprietary software for remote control and data management. The main measured parameters are usually pH, conductivity, temperature, dissolved oxygen and turbidity, but different low cost measurement solutions, supported by friendly software,

are reported by different authors [2][3]. Different architectures regarding distributed systems for water quality assessment were implemented by the authors and significant results were published during the last 10 years [4][5].

Considering the importance of the WQ parameters, the aim to develop water quality sensing nodes that are part of the design and implementation of Sado Estuary water quality monitoring network, is an important issue. This paper presents a low cost architecture for a WQ multi-sensing node based on a PIC18F4520 microcontroller and a set of WQ sensors developed in laboratory that associated with electrical conductivity, turbidity and temperature measurement.

MULTI-SENSING NODE ARCHITECTURE

The multi-sensing node architecture was designed to permit the measurement of an extended number of water quality parameters and presented in Figure 1. A low cost microcontroller is used to perform acquisition and digital control tasks associated with temperature sensing channel (TS), conductivity sensing channel (CS) and turbidity sensing channel (TUS). Appropriate conditioning circuits (Tcc, Ccc and TUcc) were developed as part of them receiving controls from the microcontrollers through DIO or PWM. Different communication interfaces of the microcontroller are used to transmit the primary processing data (UART) or to read the WQ conversion coefficients stored on the SDcard memory (SPI).

A. Sensors and Conditioning Circuits

The system sensors are a temperature sensor (TS) based on a NTC thermistor, a two-electrode conductivity sensor (CS), and a modulated four beam infrared (IR) turbidity sensor (TUS) [6]. The conditioning circuit used to convert the temperature variation T of the thermistor into a voltage, V_T, acquired by the acquisition, primary processing and communication unit includes a voltage divider with low tolerance resistors, a voltage follower, a differential amplifiers and an inverter

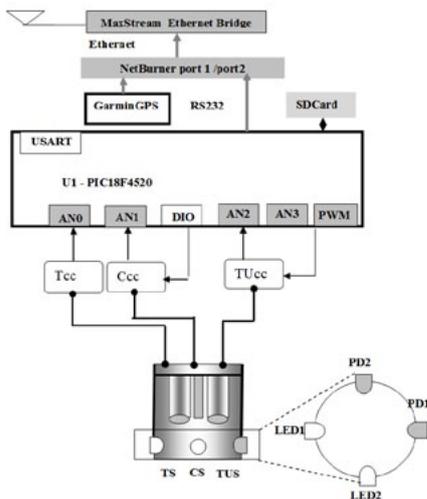


Figure 1. WQ multi-sensing node block diagram (TS-temperature sensor, CS – conductivity sensor, TUS- turbidity sensor, Tcc- temperature conditioning circuit, Ccc – conductivity conditioning circuit, TUcc – turbidity conditioning circuit, Netburner – 2XRS232/Ethernet bridge)

The conductivity conditioning circuit is based on a monolithic integrated circuit function generator XR-2206 that provides the AC excitation signal applied to the conductivity electrodes. The measurement of the conductivity cell impedance was done using different frequencies of the AC excitation signal. Good results were obtained for a frequency around 10 kHz and a 6 Vpp signal amplitude. Considering the conductivity dependence with temperature, a temperature compensation algorithm that uses the voltage values acquired from the temperature (V_T) and conductivity (V_C) measurement channels was implemented at the microcontroller level.

The architecture for the turbidity sensor includes a set of two IR LEDs (LED1 and LED2) and two infrared photodiodes (PD1, PD2) [6]. A pulse-width modulation signal is used for current drivers control to assure appropriate current for better sensitivity of the optical turbidity measurement cell. Thus, by varying the duty cycle of the control signal output by the microcontroller PWM1 ports, and using $f_c=1\text{Hz}$ low pass filters followed by voltage-to-current converters, excitation currents up to 60mA are obtained, which guarantees a high optical excitation power for low range turbidity measurement values (0-100NTU). When higher values of turbidity are expected the measurement range is automatically changed through the usage of reduced value of duty cycle of the PWM signal meaning low excitation current applied to the IR LEDs. The sets of voltages obtained from PD1 and PD2 for two measurement phases (LED1=on, LED2=off; step2: LED1=off, LED2=on) are used to calculate the TU values by the microcontroller.

B. Microcontroller and Interfaces

The multi-sensing node architecture is based on PIC18F4520 microcontroller that includes a set of three A/D converter channels (AN0, AN1, AN2) with a 10bit resolution. Additionally, microcontroller's digital lines (DIO0) are used to control the Ccc, and PWM1 port is used to control the CC_{TU}. Taking into account the nonlinearity of the conductivity measuring channel, a voltage to conductivity conversion algorithm was implemented based on 3rd order polynomial model that was calculated using the experimental characteristics of the conductivity measuring channel $V_c=V_c(\text{CSi})$ [uS/cm]. A linear temperature compensation $C_T = C_{Tcal} (1+\alpha \cdot (T-T_{cal}))$ was used to normalize conductivity measurements for a temperature equal to 25 °C (T current temperature, Tcal reference temperature, usually equal to 25°C, α -temperature coefficient that is about 0,02 for salt water solutions).

The turbidity calculation is based on acquisition of the $V_{11}, V_{21}, V_{12}, V_{22}$ voltages using the AN2 and AN3 microcontroller analog inputs. The absorbance compensated TU measurement values are given by [7][8]:

where C0TU and C01TU are the values of the coefficients that are obtained in the calibration phase when different formazine standard solutions (e.g.

$$TU = C_0^{TU} + C_{01}^{TU} \cdot \sqrt{\frac{V_{11} \cdot V_{12}}{V_{21} \cdot V_{22}}}$$

TUS1=20NTU, TUS2=80NTU) are used. The calculated WQ values are transmitted through RS232 communication on the NetBurner SB72-EX low cost, high performance Serial-to-Ethernet converter that receives the information from the GPS

module. Using a Wireless Ethernet Bridge from MaxStream [9] the digital values of the WQ parameters are transmitted to the base station. A LabVIEW software implemented by the PC assures data reading, and advanced processing of the WQ values (e.g. temperature compensation and short time data prediction), data storage and a WQ database that can be used to generate dynamical WQ web pages [10].

RESULTS AND DISCUSSIONS

To obtain the parameters associated with the inverse models of WQ measurement channels that permit the conversion of the acquired voltages into WQ levels (e.g. voltage to temperature conversion, voltage to water conductivity conversion, voltage to turbidity conversion) an experimental work was done. Using a temperature controlled oven, a set of five temperatures were imposed in the 5°C to 25°C interval and the linear approximation of temperature measurement channel characteristics were obtained. The inverse modeling of the water conductivity measuring channel was done using a set of conductivity standard solutions from Oakton (CSS1=84uS/cm, CSS2=1413uS/cm, CSS3=2784uS/cm, CSS4=15000uS/cm). The acquired voltages were used to extract the polynomial approximation of $C_{Tcal}=C_{Tcal}(V_c)$ characteristic.

Regarding multi-sensing node evaluation, different tests were performed to verify measurement accuracy taking as reference measurements delivered by a Quanta Hidrolab reference multi-parameters' probe. In this moment the team is working to develop an improved version of Geographic Information System [10] implemented on the base station level that receives data from the implemented multi-sensing node.

IV. Conclusion

A microcontroller based architecture for water quality multi-parameters sensing node was designed and implemented. The temperature, conductivity, and turbidity sensing channels were designed and implemented and different laboratory tests were carried out. The embedded system assures the control and data communication associated with WQ quantities that are transmitted to a PC that performs data processing, data storage and data representation tasks. Through calibration and using appropriate inverse models for the measuring channels characteristics, accurate values of WQ measured quantities were obtained. Elements of system calibration, inverse modeling and base station software are part of the final version of the paper.

ACKNOWLEDGMENTS

This work was supported by Instituto de Telecomunicações (IT) and Fundação para a Ciência e Tecnologia (FCT).

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SENSING TECHNOLOGIES FOR MONITORING MARINE ENVIRONMENT

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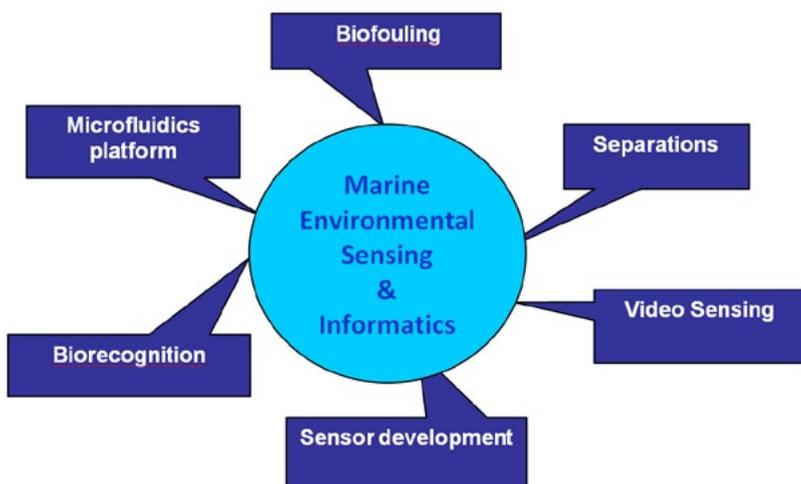
The lack of affordable, self-sustaining platforms for monitoring marine water quality means that measurements are done primarily through grab sampling at a limited number of locations and time, followed by analysis back at a centralised facility. This has resulted in huge gaps in our knowledge of water quality. This project aims to develop platforms capable of remote sampling and analysis over extended periods of time. This would provide the building blocks for establishing an 'environmental nervous system' comprised of many distributed sensing devices that share their data in near real-time on the web. The envisaged 'environmental nervous system' allows marine environment to be closely monitored, enabling the early detection of pollution events to minimise the danger to people and contamination of distribution systems.

This work is undertaken by the Marine and Environmental Sensing Technology Hub (MESTECH) which is formed by a multidisciplinary team of researchers with expertise in analytical science, sensor development, and visual imaging to the development of innovative technology solutions for the marine environment. This project is part of a marine focus initiatives called Beaufort marine research awards funded under the Marine Research Sub-Programme of the Irish National Development Plan 2007–2013. These awards anticipate to significantly develop overall Irish research capacity with a view to positioning Ireland's marine sector within a global knowledge-based economy.

This paper presents the technological developments that are essential for deployable sensing systems for monitoring marine water quality such as water turbidity, nutrient level, toxic algae etc within this Beaufort Marine research project. Important challenges associated with field-deployable sensors in marine environment are addressed. These include biofouling, wireless communi-

cations, data handling & analysis and power management etc. Research works involved are summarised below and shown in Figure 1:

- Anti- biofouling surface – Inspired by nature, synthetic surfaces with anti-fouling properties were developed by mimicking the surface micro structure of living marine creature such as shark and crab.
- Micro-separation technologies for simultaneous separation and detection of multiple target species within marine samples – low pressure micro column packed with surface modified monoliths were developed for rapid separation of ions and heavy metals.
- Sensor network based on visual sensing to monitor the coastal marine environment – Powerful tool for environmental monitoring can be realised by using camera based sensing technology combined with weather information readily available. Monitoring of estuary/ river water level combining information such as rainfall, temperature....etc. gives accurate prediction of water level and can be used as warning system for flooding.
- Develop highly stable and specific antibodies for detection of marine based biotoxins – Novel antibodies for biotoxin were developed for bioassay.
- Microfluidics based autonomous instrument for nutrient analysis – Autonomous wireless nutrient analyser based on microfluidics has been developed for long term field deployment (see Figure 2). This instrument is the centre piece where other sensing techniques would be incorporated in the future to realise multi-analyte analyser.
- Low cost optical sensing devices for water quality monitoring – LED based sensor for colour and turbidity measurement.



(left) Figure 1. The Beaufort project adopts an integration approach for developing marine sensing network.



(right) Figure 2. Microfluidic based autonomous nutrient analyser.

STUDY OF THE VERTICAL DISPLACEMENT OF THE OCEANOGRAPHY SURFACE BUOY INMERSED IN A CURRENT FOR A SNACK MOOR WITH ELASTIC LINE IN BAY CADIZ

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Abstract - This paper presents the study of a surface buoy that is anchored to the bottom with an elastic line. The buoy incorporates GPS sensor that record the movement. We investigate the downstream excursion of the buoy immersed in a current which vary with depth. A numerical model has been developed to support the prediction of the equilibrium configuration in an offshore operation condition. The installation of a current meter yielded information on the vertical variation of current velocities.

Keywords: buoy, elastic line

1. INTRODUCTION

The great majority of the oceanographic surface buoy systems have only one anchoring point. Cost efficiency and easy of implantation result from their simple configuration. The size, shape and material of the buoy vary with the requirements and the depth where it is installed. The scope of the mooring line was large. A small scope present the disadvantages of high dynamic loading due to wave action and high static tension under strong current conditions. The high stress are reduced when the scope of the mooring line is increased. However, the motion of the flota and the sensor are large.

The static equilibrium configuration of the cable is determined by using the followings assumptions:

- The hydrodynamic flor is stationary, with a know profile
- We neglect the tangencial component of the hydrodynamic force.
- The weight of the water displaced by the buoy is constant.

2. MATERIALS

A surface buoy Galicia model was selected. This buoy has a depth of 2.20 meters and a reserve buoyancy of 140 kg. It is constructed of polyethylene and its underwater part can be approximated to a cone. On the buoy was installed brand GPS JAVAD with ability to record positions with differential corrections. Anchoring current profiler allows to study variations in the speed with depth. Stranded to the fiber rope, were installed three pressure sensors that recorded the vertical displacements. The cable geometry resulting from this computation is then compared against known displacements.

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STUDY OF A MOORING LINE WITH A SSBO BUOY

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Abstract

Buoys and floats provide the buoyancy necessary to adequately support the anchoring lines and the system instrumentation and ancillary equipment. This paper introduces laboratory results and experimental measurements in order to predict the behaviour of mooring system with a sunfish-shaped buoy. The model is validated by analyzing the vertical displacement and angle of inclination of a mooring with a current profiler. A second current meter, with the same characteristics, is placed on the seabed. Errors due to inclination of the instrument is obtained by the difference in measures.

Keywords: Drag coefficients, Buoy, Mooring line.

1. INTRODUCTION

Oceanographic moorings are composed of instruments, cables or ropes and buoyancy elements. The inclination of oceanographic mooring lines due to current drags causes errors in time series observations of oceanographic variables such as currents, salinity or temperature. Mooring design require studing the minimum buoyancy to keep the mooring line straight in the vertical. The degree of inclination of the mooring line is critical in the error of the measurements of the instruments. When mooring lines reach very high inclinations, some measuring instruments begin to measure wrongly or measures are subject to large vertical variations which may create uncertainty in the measurement. In the case of the current meters, which need a compass to determine the cur-

rent direction, this angle limits the validity of the measure. Typically, the buoyancy elements are spherical or cylindrical shapes. Buoys and floats provide the buoyancy necessary to adequately support the anchoring lines and the system instrumentation and ancillary equipment. The size, shape, and material of the buoy vary with the mooring requirements and the implantation depth.

2. EXPERIMENTAL METHOD

When a buoy is in a viscous fluid it experiences a gravity force, W , a buoyant force, B , and a resistance force, F_D . The gravity force is constant and acts in the downward direction, the buoyant force is also constant and acts in the upward direction, the resistance force, however acts against the direction of motion and is an increasing function of the speed of the object. The drag force, F_D , consists of friction and pressure forces as a result of tangential and normal stresses acting on the surface of the elements.. The resultant force is obtained by integrating the shear and pressure stresses over the area of the element and is called the resistance force. This force has two components called drag in the direction of flow and lift in the direction normal to the flow (Randall, 1997). The drag force is primarily form drag and can be expressed as,

$$F_D = C_D A \frac{\rho V^2}{2} \quad (1)$$

where F_D is the drag force, C_d is a dimensionless drag coefficient, ρ mass density of the fluid, A is the frontal area of the body exposed to the flow and V rela-

tive velocity. The drag coefficient is a characteristic dimensionless number for a body, depending on the Reynolds number Re and the direction of the current with respect to the body. Drag coefficient curves for spheres and fan plates are often described in reports of fluid mechanics (Lamb, 1932; Hoerner, 1965; Pierson et al, 1960). When a body heavier than water is left free to sink, it first accelerates under the action of gravity. As its speed increases, its immersed resistance, F_d , increases. Sooner or later the external forces on the body are equal, and the body sinks with a constant terminal velocity. The balance of the forces at the time is

$$F_D = \frac{1}{2} \rho C_D A V^2 = W - B \quad (2)$$

where W is the weight of the body and B is the buoyancy of the body. The terminal velocity is

$$V = \sqrt{\frac{2(W - B)}{\rho C_D A}} \quad (4)$$

when the drag coefficient for the particular body shape is highly sensitive to Re number, then the problem must be solved by trial and error. The terminal velocity is first assumed, the corresponding Re number and coefficient C_d found, and a first computation of the terminal velocity made with this value of C_d . If mooring line is inclined from vertical due to horizontal currents forcing, the procedure proposed in this paper is equivalent to that described above where the balance of forces over the buoy is

$$\begin{aligned} x: \quad T \cos \phi &= F_{D_x} = \frac{1}{2} C_{D_N} A_N \rho V^2 \\ z: \quad T \sin \phi &= B - W \end{aligned} \quad (5)$$

where T is the tension of the cable and ϕ is the inclination of oceanographic mooring line. A_N is the frontal area of the buoy. The float is fixed to the bottom as shown in Figure 1. A short piece of wire of small section, inelastic and negligible mass is used. The cable bending stiffness and the torsion stiffness are neglected. When equilibrium is reached, we can obtain C_d as

$$C_D = \frac{2(B - W) \cot \phi}{\rho A_N V^2} \quad (6)$$

The drag force is assumed to act through the centroid of the projected area, A_N (Randall, 1997). For cables the normal and tangential forces are commonly assumed to be proportional to the square of normal and tangential velocity components respectively, with corresponding drag coefficients C_{DN} and C_{DT} taken constant and independent of the angle to flow direction (Finke and Sielder, 1985). In this case drag forces are composed of normal and tangential components. As a simplifying assumption, the procedure does not calculate lift for the elements in the mooring. The experiment is performed in a tidal channel with little depth and width. An ADCP current meter is installed on the bottom records the flow velocity, V , during the experiment. The pitch sensor that incorporates the current meter records the angle of inclination. The analytical study of mooring systems behaviour is done by Mooring Design and Dynamics (MDD) software. MDD is a set of Matlab® routines that can be used to assist in the design and configuration of single point or single anchor moorings and the evaluation of mooring tension and shape under the influence of current (Dewey, 2007).

3. THE TESTED MOORING COMPONENTS

As a flotation was selected special buoy, designed by Innova Oceanografía Litoral S.L., with the shape of sunfish to reduce the drag force. For this body the smallest drag is obtained when the long axis is parallel to the flow direction and the blunter end is heading upstream (Fig 2). The mooring line is completed with a short rope and a heavy anchor.

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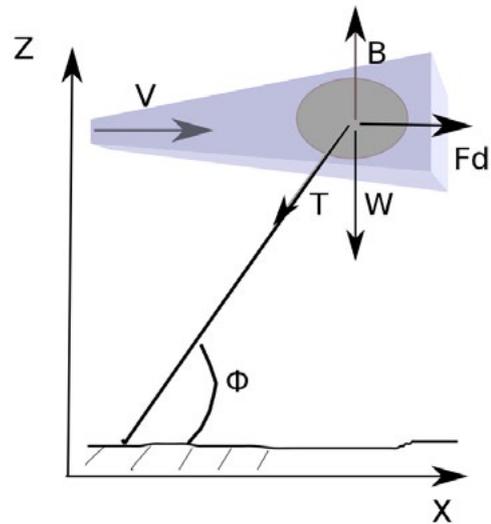


Figure 1. Forces acting on a buoy

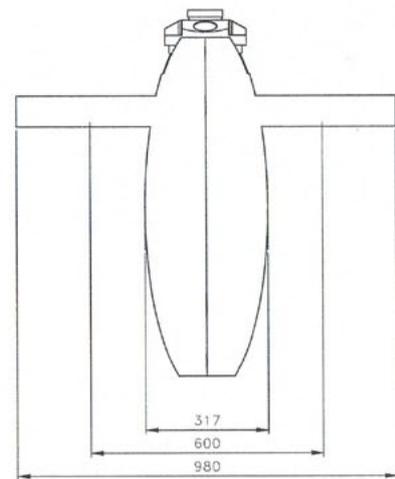
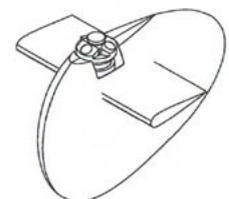


Figure 2. SSBO buoy



PANEUROPEAN R&D ON VERY LARGE OFFSHORE WIND TURBINES: THE HIPRWIND PROJECT

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HiPRwind (read "hyperwind") is an EU project introducing a new cross-sectoral approach to the development of very large offshore wind turbines. Focused on floating systems, this 5-year pan-European R&D effort will develop and test new solutions for enabling offshore wind technologies at an industrial scale. The project is designed with an "open architecture, shared access" approach in that the consortium of 19 partners will work together, in a collaborative way, to develop enabling structural and component technology solutions for very large wind power installations in medium to deep waters. Results of general interest will be shared within the broader R&D community working on future wind energy solutions.

A central outcome of HiPRwind is to deliver a fully functional floating wind turbine installation at approximately 1:10th scale of future commercial systems, deployed at real sea conditions. This research & testing facility, a world's first, will be used to research new solutions and generate field data. The project will address critical issues of offshore wind technology such as the need for extreme reliability, remote maintenance and grid integration with particular emphasis on floating wind turbines, where economic and technical weight and size limitations of wind turbines and support structures can be overcome.

As can be seen in Figure 1 and Figure 2, prepared by Acciona and 1-TECH in the context of the project MARINA Platform, the offshore wind resource available in shallow waters is very limited and it is needed to find solutions for deepwater areas.

Innovative engineering methods will be applied to selected key development challenges such as rotor blade designs, structural health monitoring systems, reliable power electronics and control systems. Built-in active control features will reduce the dynamic loads on the floater in order to save weight and cost compared to existing designs. HiPRwind will develop and test novel, cost effective approaches to floating offshore wind turbines at a lower 1-MW scale.

In this way, the project will overcome the gap in technology development between small scale tank testing and full scale offshore deployment. Thereby, HiPRwind will significantly reduce the risks and costs of commercialising deep water wind technology. The HiPRwind project will make use of existing test locations which offer a favourable permitting situation and infrastructure such as grid connection and monitoring facilities already in place.

The main aspects that the project will deal with are:

- Design of the floating support structure and its moorings system.
- Construction of the full demonstrator unit, its assembly at port facilities and installation at the offshore test site.
- Critical aspects of the floating wind turbine, such as the structure and its system dynamics, the controller, condition and structural health monitoring systems, and the rotor based on innovative blade designs and features.
- High reliability power electronics will be designed, assembled and tested in the lab at a multi-MW scale.

The project also has dedicated work for dissemination and Intellectual Property Rights exploitation, addressing also non-specialist and non-technical target groups, as well as project management drawing on both research and industry consortium members.

The full impact of the HiPRwind project will be ensured by the strong and close collaboration of participating best-in-class industrial and R&D players in the maritime and wind energy sector with a strong background on successful industrial development in harsh environments.

HiPRwind is a collaboration between nineteen partners from all around Europe. This research project has received funding from the European Union's Seventh Framework Programme [FP7/2007-2013] under Grant Agreement Number 256812.



Figure 1: Simplified European Bathymetry

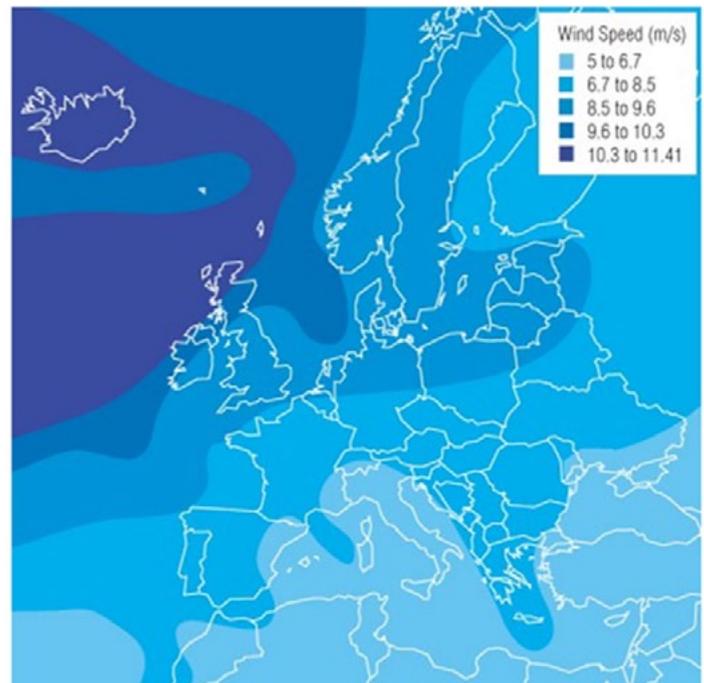


Figure 2: Wind speed areas in the same area.

METHODOLOGY FOR TIDAL ENERGY RESOURCE ESTIMATION AND EXPLOITABILITY: QSAIL APPROACH

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A study of the potential for ocean energies in the southern Spanish region of Andalucía is reported, using state-of-the-art methods for characterization of the resources and a comprehensive analysis of the technology status in this emerging field. The study shows that the tidal/marine current potential in the Straits of Gibraltar is a world-class resource, with a theoretical power capacity of up to 7 Gigawatt, GW. Even if only a small fraction of the resource can be extracted, as is likely, it would still rank among the most important sites in the world for tidal/marine current energy. It is considered that this resource, combined with proximity to the grid and to major power consumers, could be large enough to attract companies to customize or develop novel technological solutions for the resource.

A detailed physical and bathymetric description for the entire coast of Andalusia has been created, drawing on scientific competence at the University of Cadiz, Department of Physical Oceanography.

The results obtained were

1. Mapping of the tidal current resource.
2. Technological and non- technological determining factors;
3. Review of energy conversion technologies and maturity.
4. Applicable legislation and regulations.
5. Techno-economic viability methodology and case study.
6. Potential for Andalucía's economic development.

The mean peak current distribution map obtained for the Straits is seen on Fig. 1.

1. The areas of concentrated energy are clearly seen and are caused by a complex interaction of the outflow (westwards) of the colder and denser deep Mediterranean waters and the tidally influenced flow of the warmer Atlantic surface waters, both in turn being controlled by the complex bathymetry.

The energy in marine currents depends on velocity to the third power, $P \sim Vc^3$; thus, accurate and localised measurements of flow are required in order to estimate the energy that can actually be extracted. Most converters under are designed for flows of more than 2 m/s, however, very large water areas in the Straits are flowing at velocities of 1.5 m/s or higher, so there should be many locations to consider for ultimate commercial installations.

EnerOcean has verified with the help of University of Cádiz that the models are accurate and that the values for selected places are in line with these verifications into the Q-Sail project.

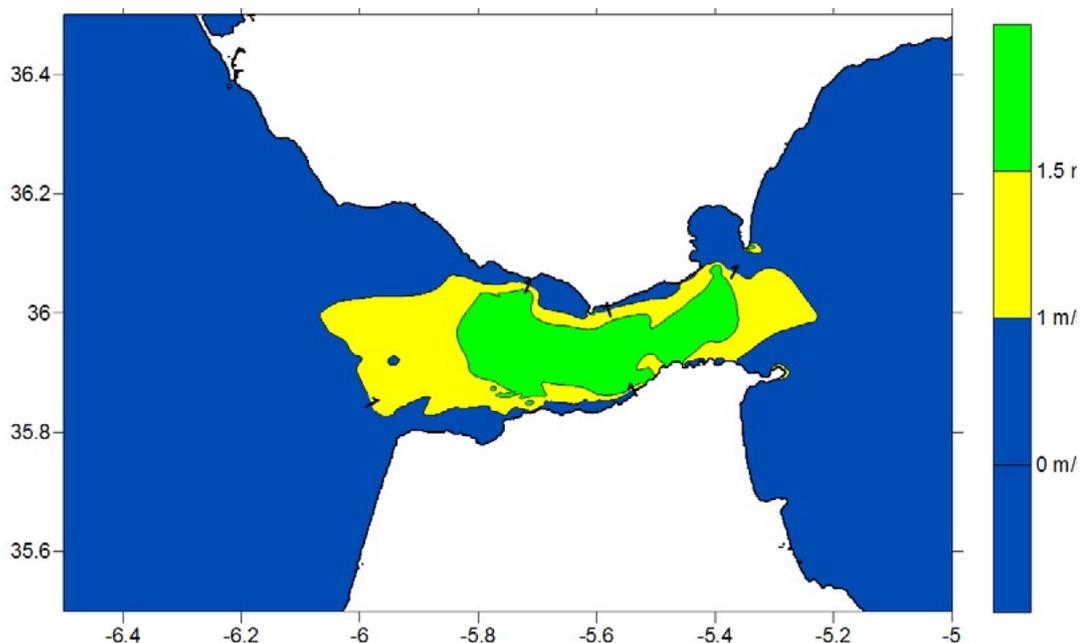
Among the other technological determining factors for tidal/marine currents, the range of depths and the slope and nature of the seabed were found important. Various non-technological determining factors need to be taken into account as well, such as protected areas, shipping, fisheries and other uses of maritime space, undersea cables, pipelines etc. For the Straits, detailed sea-use maps have been prepared to show the location of such complementary activities and aid in delineating possible exploitable sites.

For a case study, a site was identified near (but not inside) one of the most concentrated areas, which is outside of all natural parks, fishing zones and maritime traffic routes. The sea bed here is rocky, relatively flat, and the modelled tidal currents show modest velocities but with a favourable directionality.

A model was created for techno-economic analysis of tidal current installations, and used for the site and a hypothetical installation of a novel technology. This case study illustrates the possibility for developing a tidal site in the Straits of a commercial value comparable to other renewable energy sources. In addition, tidal power is predictable years in advance and so has better dispatchability than most other renewable sources such as wind or solar.

Finally and as a method to simplify the application of this methodology to different sites around the World, in this paper a simple method for tidal current modelling in short length convergent elongated channels is presented. The authors have found that for this kind of channels a very suitable approach to tidal current velocity estimation can be obtained through a very simple formulae. This method has been developed to obtain reliable along channel tidal current velocity estimations using as less information as possible. In fact, the only necessary information to apply this method are the harmonic constants of the tidal elevation at any location in the channel and a proper nautical chart. We present a graphical method to inquire when the geometrical characteristics of a given channel allow the application of our approach.

Q-SAIL is an European collaborative project Eurostars with number e*4409, Spanish work has been cofunded by CDTI using funds from PLAN E: "Plan Español para el Estimulo de la Economía y el Empleo".



METHODOLOGY FOR TIDAL ENERGY RESOURCE ESTIMATION AND EXPLOITABILITY: QSAIL APPROACH

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Tidal Energy is one of the most promising renewable energy sources to be picked up. Tidal energy conversion presents a complex engineering challenge: to produce affordable, competitive energy in one of the most challenging natural environments, where access for maintenance is expensive and high risk

During the last decade various types of the tidal power plant prototypes were developed, some of them contain special hydrofoils, other based on blades similar to the ones used in wind energy and other alternative solutions, like sails.

The TidalSense system will address part of this challenge by using long range ultrasonic technology (LRUT) to provide remote structural health monitoring (SHM) of significant tidal turbine structures. Structures under investigation at this stage of development are load bearing cables and composite structures (specifically turbine blades), but the technology can ultimately extend to all significant TEC structures.

The TidalSense technology has the potential to reduce cost and improve quality through the following key aspects:

QUALITY CONTROL: Enabling to check their components prior to release, reducing risk and improving customer warranty confidence.

ADVANCED FAILURE WARNING: Enabling operators to pre-empt component failure, decide whether to shutdown the machine, and planned maintenance rather than reactive maintenance.

REDUCED ONSITE MAINTENANCE: To reduce the frequency of machine inspection reducing risk and cost by providing this ability remotely. Tests more frequent and from the safety of the shore.

DESIGN ENHANCEMENT: Providing machine developers with a highly valuable assessment of in service degradation of structures and design weak points, enabling parallel development of improved machinery and early warning for common design errors (product recall / improved maintenance before failure).

Even at its nascent stage of development, the tidal energy industry has already suffered serious failures that could have benefitted from remote structural health monitoring systems, both to pre-empt failure and to learn valuable lessons in the event of those failures. Industry leaders have already succumbed to machine stopping blade failures.

Due to continuous operation under the harsh marine conditions, such constructions should have been periodically tested against the faults. In the TIDALSENSE project two concepts are being studied, the inspection of Multi-Wire Steel Cables Using Long Range Ultrasonic Testing (LRUT) and the use of ultrasonic guided waves for the condition monitoring of the composite material elements. Multi-wire steel cables are used in many engineering infrastructures. They are considered to be safety critical components. In marine energy they are used for tension mooring and as driving elements in several devices. The location and operation of the multi-wire steel cable ensures they can be subject to variations in; temperature, pressure, and pre-/post- stress. These conditions can potentially induce cracks, corrosion, delimitations and brittleness within the multi-wire

steel cables. This could result in a potential source of unreliability, which could lead to failure. Therefore, there is a need for an effective examination technique that can assess the condition of the multi-wire steel cables before any malfunction takes place. Long Range Ultrasonic Testing (LRUT) has been selected as Non-Destructive Testing (NDT) technique to inspect cables for defects or discontinuities. LRUT uses ultrasonic guided waves in the kilohertz range (typically between 20-300 kHz) to inspect for defects from single point of access for many meters (up to 100m) with full volumetric coverage. The aim of this work is to demonstrate the ability of LRUT to propagate and detect defects within the multi-wire steel cables. The work was conducted using FEA analysis along with experimental validations. The findings show that the fundamental axisymmetric wave mode, L(0,1), can propagate within the multi-wire steel cable (up to 8m) at a frequency region between 16-20 kHz with the ability to detect defects over a distance of many meters away from the ultrasonic excitation/reception region.

Talking of the monitoring of composite material elements, the case study was an hydrofoil. The overall structure of hydrofoil is very complicated as the skin and the main spar are made from glass fibre and carbon fibre composite, filled by foam. Inspection of so complex object is a great challenge for conventional non-destructive testing (NDT) techniques.

The objective of the presented work was to determine the most critical regions of hydrofoil to be tested, to select the modes of ultrasonic guided waves to be used and to determine the parameters of their excitation, propagation along the sample and interaction with non-homogeneities.

The analysis of the multi-layered structure of the hydrofoil to be inspected using ultrasonic guided waves was performed. The geometry, material type, properties and the critical regions of the hydrofoil that should be tested were identified. The dispersion curves of phase velocity of the guided waves propagating in the multi-layered structure of hydrofoil have been determined using SAFE method. The propagating modes of guided waves in the multi-layered structures of the skin and the main spar were identified using modelling and experiments. It was estimated, that in order to use the fundamental modes, the frequency range of operation below 200 kHz should be used for inspection of the skin and even lower for inspection of the main spar. The testing of main spar should be performed in longitudinal direction and other parts of hydrofoil - along perpendicular direction due to special orientation of fibres in the composite. It was shown that even in the case of limited number of transducers embedded into recommended positions the necessary coverage of the object can be achieved.

TIDALSENSE is a collaboration between the following organisations: TWI LIMITED, CERETETH, ENEROCEAN, I&T NARDONI, IKNOWHOW, INNOTECH, IT POWER, KAUNAS UNIVERSITY OF TECHNOLOGY, TIDALSAILS. The research leading to these results has received funding from the European Union's Seventh Framework Programme managed by REA-Research Executive Agency <http://ec.europa.eu/research/rea> [FP7/2007-2013] under Grant Agreement Number 232518.

MODEL OF A MOORED POWER CABLE AT OBSEA PLATFORM

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Abstract: New green energy sources deployed at sea in mobile platforms use power cables in order to transport generated energy at sea surface to the bottom. These power cables are exposed to the dynamic behaviour of the platform movements due to waves, currents and wind. OBSEA is a seafloor cabled observatory at 20 m depth in front of Vilanova, in Catalan coast, that captures data in real time like current, waves, wind among others.

In this paper, a model of a moored power cable installed at OBSEA is studied. The study is focused on the trajectory, tensions and deformation or curvature of cables about 0.1 m diameter and under real conditions collected from OBSEA sensors. Simulations are done with Orcaflex 9.4 environment. This software al-

lows to model underwater structures and cables.

Figure 1 shows some results of a moored cable of length 45 m in a small depth (15 m) under sea waves of period 8s and height 8m. In particular the behaviour of top end cable (EndA) is shown: the horizontal (x), vertical (z) and tension as a function of time is shown.

Figure 2 shows some projections of the temporal results. In particular the trajectory of EndA and tension versus z are shown. Valuable information can be obtained easily like: EndA behaviour inherits the periodicity of sea waves, the oscillation of EndA describes an ellipse, at which vertical position the tension is maximum among other information.

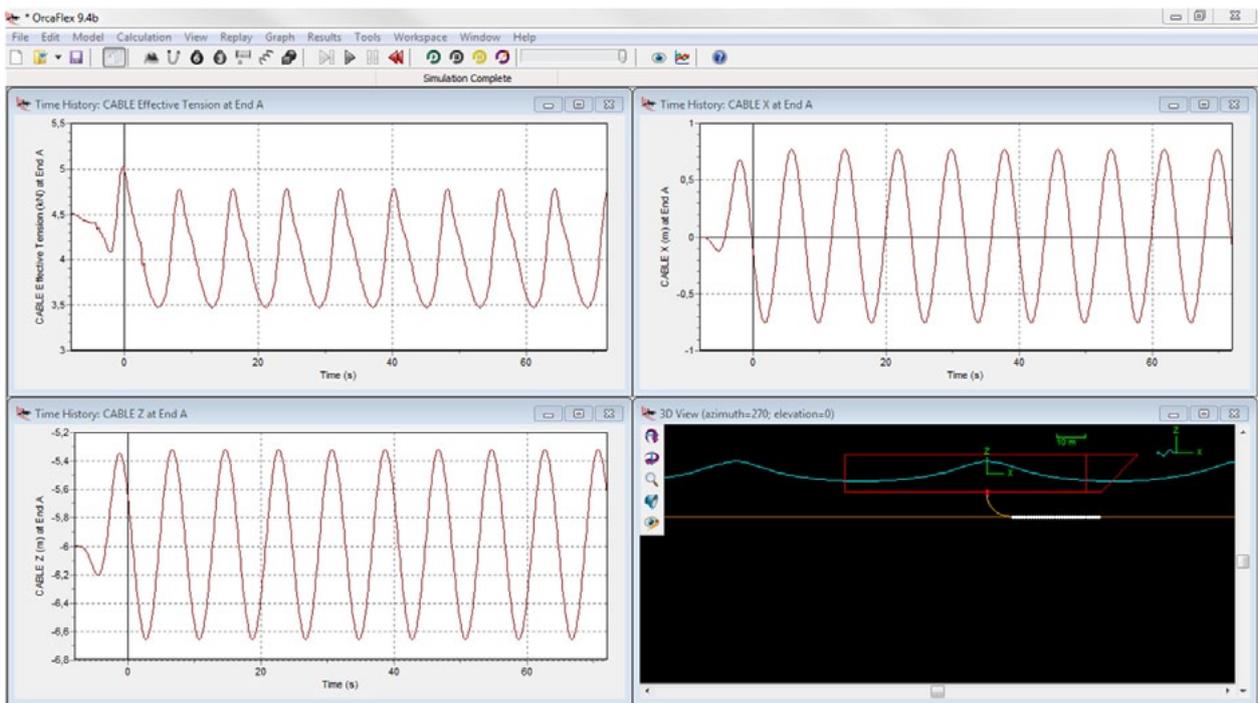


Figure 1. Cable tension and positions on top of cable. Sea depth 15m, cable length 45 m with diameter 0.1[m] and Bending stiffness 7 kN·m². Periodic waves conditions: period of waves of 8 s and height 7 m.

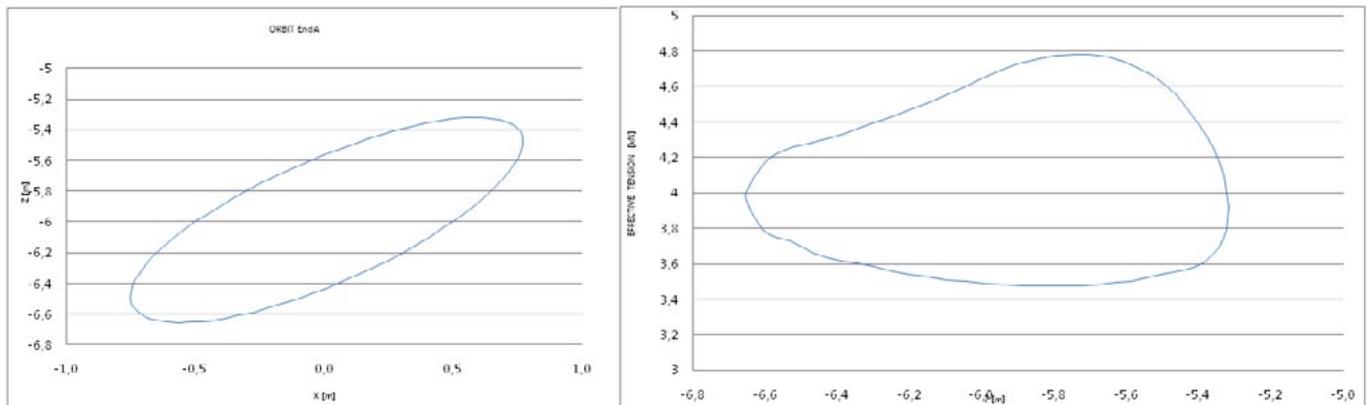


Figure 2. Projections of behaviour of top cable (EndA): Vertical coordinate z versus horizontal x. Tension versus z.

MONITORING THE “SALINA LA LEOCADIA”, A PILOT EXPERIENCE OF MULTI-TROPHIC AQUACULTURE

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Abstract: The monitoring of salt marsh for IMTA project can not be raised as in off-shore projects. These are areas of calm waters, where high temperature and the existence of earthlings and biogenic inputs (nutrient salts and organic matter) permit growth of phytoplankton and algae, which contributes to a further enrichment of the waters, with the corresponding increase of fouling. These features, along with the distribution of the salt marsh, make monitoring particularly difficult.

Keywords: Monitoring, multi-trophic aquaculture, salt marsh.

1. INTRODUCTION

The company “Cultivos Marinos Integrales S.A.” was founded in 1989 and has developed its productive activity from 2009 in Salina Santa Leocadia, in the town of San Fernando, Cadiz, located in the “Bahía de Cádiz” Natural Park.

These facility was designed to take advantage of the tidal movement for water renewal, which means significant energy savings, for the semi-intensive cultivation of sea bream, sea bass and meagre in 26 ponds, with a total annual production of 700 tons, commercialized fresh.

Within the project “Marine Culture National Plan JACUMAR Integrated aquaculture” an IMTA pilot experience with pacific oyster (*Crassostrea gigas*) was carried out. It has been designed taking into account the special characteristics of both bio-environmental and hydrodynamic site, where tide, controlled by a system of pumps and floodgates, allows 400% daily renewal of water. 8 stations have been installed, two of them for control (E1, E2) on each input canal of the installation and six experimental stations distributed along the output canals (S1 to S6) (Fig. 1). The distribution was made in order to study the influence of the amount of fish farm water waste on the growth of oysters. To carry out the monitoring of environmental parameters a CTD Seabird 19, a fluorometer ECO WET Labs and a current meter RCM9 Aanderaa. were installed

2. STUDY AREA

Situated in an old salt marsh converted for marine aquaculture development, located in San Fernando and in the Cadiz Bay Natural Park, opposite the Campo Soto beach has an area of 103.127m² in which 26 ponds are used for cultivation. The system works with the natural tidal movement, but has two water reservoirs, a pumping system, a system of oxygen and the corresponding input and output canals of seawater. It receives water supply from “Caño Sancti Petri” creek.

3. METHODOLOGY

The CTD Seabird 19 was installed in the input canal (E2), and the current meter RCM9 and the fluorometer in the output canal (S4 and S6, respectively) (Fig. 1).

4. RESULTS

The environment in which this study was developed is very aggressive with the instruments, and a great amount of fouling and mud was stick onto them in a short period of time.

After an initial phase in which the instruments were cleaned every 15 days it went on to another phase in which this was done every week. However, in the case of CTD (input channel), by relying on a pump that circulates the same portion of water through its various sensors, the high turbidity of the medium made the pump collapse, and distorts some data, such as dissolved oxygen in the periods prior to cleaning.

The fluorometer Wetlabs is provided with an anti-fouling bio-wiper™ and faceplate that extend the possible deployment duration by retarding biological growth on the instrument's optical surface. The Bio-wiper™ covers the optical surface while the instrument is in “sleep” mode or when it has completed the number of samples requested. When the meter wakes up, the optical surface is exposed by the Bio-wiper's™ counterclockwise rotation. In normal conditions

(open sea) it works properly for months, but in this case it was not enough, and the system had to be cleaned weekly.

The current meter RCM 9 utilizes the well-known Doppler shift principle as the basis for its measurements. The system transmits an acoustic sinusoidal pulse at 2MHz. As the sound propagates through the water, minute parts of its energy is reflected or scattered by small particles in the water. This back-scattered energy is received by the system and analyzed to find any change in frequency. An upward shift in frequency means that the particles are moving towards the transducer and a downward shift that the particles are moving away from the transducer. The degree of shift signifies the rate of movement.

Assuming that the particles follow the currents in the water, this system is used to monitor and determine the current speed and direction of the water. The direction is found by the use of measurements along two orthogonal axis and linking them to true north by use of an internal compass reading. Therefore, even when the instrument was completely covered by fouling, the data were always correct.

5. CONCLUSIONS

The CTD is not a suitable instrument to place in salt marsh areas, because its pump collapses with the mud and fouling of the environment. The fluorometer Wetlabs works well in this areas because of the Bio-Wiper™ cleaning system, but it has to be cleaned frequently. The current meter Aanderaa is based on the Doppler shift, and it is not affected by the water quality.

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Fig. 1. “Salina La Leocadia”, with the location of the stations.

USE OF SIDE SCAN SONAR (SSS) IN THE MANAGEMENT OF FISHERIES AND AQUACULTURE: EXAMPLES OF APPLICATION IN ANDALUSIA, SPAIN

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Abstract - Side Scan Sonar (SSS) is a hydroacoustic device capable of georeferenced seafloor imaging with a very acceptable resolution and accuracy. Its initial development is due to military interests, but soon new civil and scientific applications arose. Currently its most important applications are related to the support to underwater archaeological heritage management, recovery and investigation of wrecks and mapping of the geomorphological structures and biocenosis of the seafloor. The present work addresses the use of this instrument to support fishery management and aquaculture by means of several projects carried out recently in the autonomous community of Andalusia, Spain.

Keyword - side scan sonar, fisheries management, aquaculture

1 INTRODUCTION

Coastal fisheries management requires a high knowledge of the site specific state of the environment, since this determines its inherent productivity. On the other hand, the control of exploitation (fishing) requires monitoring the accomplishment of the laws to be met by the fishing industry. One of the tools most used by fishery administrations throughout the EU is the installation of artificial reefs. For the monitoring of these reefs the SSS is a useful tool, providing further information on any activity that disturbs the seabed, such as trawls or shellfish traces. The fishing gears are also detected, as well as the effects of both natural phenomena (littoral drift, erosion, sedimentation) and those produced by human activities (dredging, fills, embankments, outfalls).

In the case of aquaculture, the SSS is a powerful tool in three areas: site selection, environmental monitoring, and control of mooring element.

2 OBJECTIVES

The main objective of this work is to provide the administration with both the

tools and the necessary knowledge for a more flexible and effective management of natural and off-shore aquaculture fishery resources present in the Andalusian coast.

3 MATERIAL AND METHODS

The instrumentation employed in this work is a Klein 3000 dual frequency side-scan sonar (SSS), supported by different acquisition, processing and post-processing software (sonarpro, sonarwiz, hypack, arcgis, etc.)

In all cases the methodology is based on a similar sequence of actions: detailed study of the project to be developed, design and selection of oceanographic instruments to be used in the oceanographic campaign, processing the obtained data, its representation in GIS and finally, a thorough analysis of the obtained results.

4 RESULTS

The obtained results reflect the status of the coastal fishery grounds, allowing the identification of the most vulnerable areas, as well as those submitted to more invasive actions, facilitating decision-making processes for the management of coastal fishing grounds. With regard to aquaculture, the obtained results have allowed the optimal site selection, monitoring of bottom areas adjacent to the facilities, or the identification of abnormalities in the anchoring elements that caused the most frequent faults in the related surface elements.

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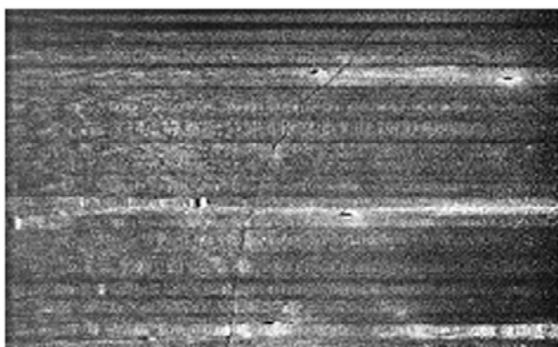


Fig 1. (left) Mooring lines in a net cage aquaculture fish farming site



Fig. 2. (right) Dredging marks among Posidonia meadows

GEOGRAPHIC INFORMATION SYSTEMS APPLIED TO SITE SELECTION FOR MARINE AQUACULTURE DEVELOPMENT IN ANDALUSIA

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Abstract: Marine aquaculture is normally developed in coastal area, marine-terrestrial public domain, where usually take also place many other uses. These areas are currently collapsed by the interference of many activities, uses and interests. In these spaces new aquaculture production projects appear, so its development and evolution is highly dependant on the amount and quality of available spaces and the administration body with competence on the particular area.

In order to achieve a sustainable development of aquaculture, the Management Service of Fishing and Aquaculture in Andalusia, Spain, Resources of the Regional Ministry of Agriculture and Fisheries has been developing since 2001 actions and studies aimed on locate suitable zones. All the information be integrated into a Geographic Information Systems (GIS) tool for aquaculture development and management, for all stakeholders.

Keywords: Aquaculture, Geographic information Systems

INTRODUCTION:

Two conditions are needed for the aquaculture development, availability of areas and environmental proper conditions. Knowing this is necessary to have obtain information about the territory. Therefore it is necessary to obtain information on aspects of the territory differentiated between administrative factors, that allow us to define the space by use and classified according to incompatibilities or limitations on aquaculture, and environmental factors, allowing us to know how to develop aquaculture according to the requirements of different species and existing farming systems.

Site selection for aquaculture development is a technical and administrative procedure by which starting with a spatial and sectorial analysis, suitable zones for the activity development are designed.

The sites selection for the aquaculture development it is technical and administrative process by which starting with a spatial and sectorial analysis, suitable zones for the activity development are determine.

MATERIAL AND METHODS:

The methodology used for the study for suitable site selection for aquaculture is based on the analysis of a large amount of spatial information processed by the GIS, with which you seek a final overview of the availability of space for business location and the factors that may affect implantation and development. GIS tool, is an Integrated System to work with spatial information. The software ArcGIS 9.3 (ESRI) is the one used on the last study presented on 2010.

The methodological process is based broadly on a preliminary study continues

with an analysis, the determination of administrative parameters and boundaries map.

After representing the thematic mapping of administrative uses and activities that take place in the maritime terrestrial space compatibility validation is performed of aquaculture development with other uses in the area of study. To do this, we have considered the following terminology associated with compatibility criteria:

Suitable Area: maritime fringe where an aquaculture facility can be located in base on the following degrees of suitability

- Suitable zone apt: where aquaculture is viable, it will not match other use or activity, or in case of coincidence use presents no inconsistency with the aquaculture and / or vice versa.

- Suitable zone limitation: the area where a is the space where it has detected a possible interference of uses, either as regulated by current legislation and / or safety criteria.

- Excluded area: marine and or maritime-terrestrial fringes in which the incompatibility with the aquaculture development is based as regulated in current legislation and / or safety criteria

Based on this classification or zoning are considered in addition to administrative parameters, a series of parameters based on technical criteria related to the location of aquaculture facilities.

RESULTS:

As a result of implementing a GIS on a relational database of current uses of the Andalusian coast, we get:

- A thematic mapping for administrative uses and activities that take place in the maritime-terrestrial space

- A thematic mapping which identifies areas of interest for the development of aquaculture

Finally, GIS can be considered as a useful planning tool for both government (as a mechanism of coordination and control of space activity), and for the private sector in search of new areas for cultivation, thus contributing the development of marine aquaculture.

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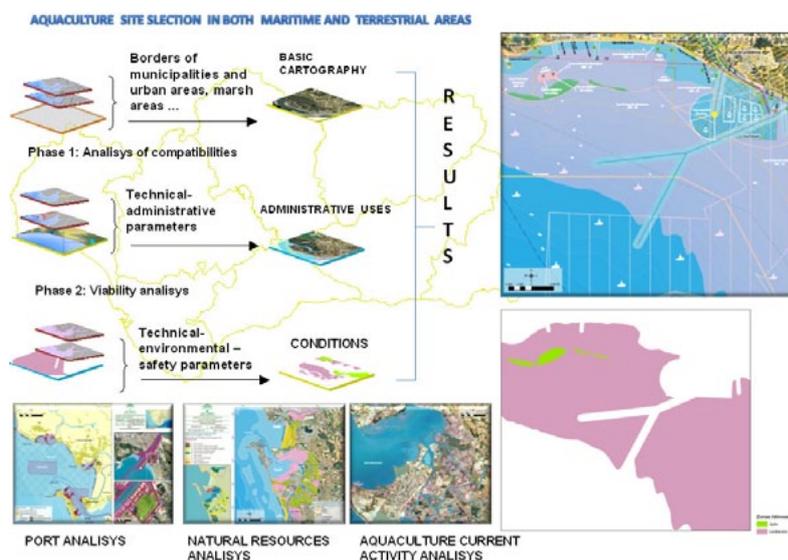


Fig. 1: Methodological scheme of cartographic phases

NUMERICAL MODELING OF MAGNETO ELECTRIC CO-GENERATOR PLANT FOR SUSTAINABLE MARINE VESSEL POWER SYSTEM

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Abstract: The number of vessel around the world continued to increase yearly to fill the world trade demand. Consequently, the fuel usage increase due to increasing requirement for propulsion and electricity. Generator is the heart of a vessel that supplies electricity to most ship's components. This study involves how to reduce the usage of generator in ship's operations. The Magneto Electric Co-generator Plant (MECP) is the combination of some equipment, electronic, circuit and recycling the shaft rotational energy for additional electrical distribution. MECP proposed to be installed at propeller shaft and main engine flywheel of UMT vessel. The regeneration system can supply electricity to auxiliaries' component of ship machineries. The total produced energy by MECP is computed by modeling numerically. Cost saved yearly is estimated based on the power produced and fuel cost. In this study, the possibility of the co-generator plant

to be used for vessel is determined by considering the efficiency and cost saving. Cost saved is compared with initial installation cost in order to determine the cost beneficial. The MECP produced 3.74 KW of power that can be used to supply the ship auxiliaries. It saved 1054 liters diesel per hour and RM 2.62 per hour in general operation cost. Major advantage included in this system is its environmental benefit because it reduces the amount of carbon dioxide footage approximated to 4.13 kg of CO₂ per hour that could be emitted to atmosphere. The system could help in commitment maritime industry to climate change compliance.

Keyword: Numerical modeling, magneto electric, co-generator, Discovery 2, vessel power

AN HF RADAR OBSERVING SYSTEM FOR MONITORING THE SURFACE CIRCULATION IN THE STRAIT OF GIBRALTAR. DEPLOYMENT AND FIRST RESULTS

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High Frequency (HF) coastal-based Radar is a unique technology to monitor, in real time, 2D surface currents and waves in the coastal areas. The Straits of Gibraltar, in particular, is an oceanographic region with unmatched confluence of important commerce, security, and oceanographic processes. The geographic scale of the Straits also are well matched to the remote sensing capabilities of a network of shorebased HF radar systems.

Initiated in the framework of the research project entitled "Analysis of the surface currents regime in the Strait of Gibraltar using a coastal-based HF radar system", funded by the Junta de Andalucía under the 'Proyectos de Excelencia' 2009 program, and now part of the TRADE project, two HF Radar stations operating at a central frequency of 24.8 MHz and a bandwidth of 150KHz, were deployed to monitor the circulation of the eastern area of the Strait of Gibraltar. One station has been deployed at Punta Carnero Lighthouse, at the southern entrance of the Bay of Algeciras, and the second station was located at the Ceuta Harbour, at the southern side of the Strait of Gibraltar. In this talk, the deployment and main characteristics of the radars (spatial resolution of the measured current fields, etc.) will be explained in detail. Moreover, a first preliminary study of the surface current fields obtained is also presented (Fig. 1), showing the great utility of this remote measuring surface current technology for different fields, ranging from physical oceanography research to oil-spill and Search and Rescue applications.

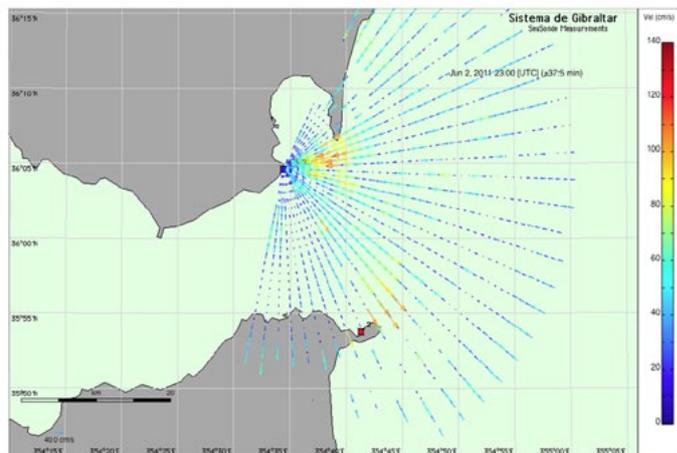


Fig. 1: Radial Velocities from HF Radar Station at Punta Carnero

THE TRADE PROJECT (TRANS-REGIONAL RADARS FOR ENVIRONMENTAL APPLICATIONS). A CONTRIBUTION TO THE PRESERVATION OF THE ENVIRONMENT BASED IN RADAR HF

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HF radar is a technology able to provide measurements of real time 2D surface current fields. This technology is being currently deployed on both coasts of the United States (150 radar stations built by NOAA in 2010). Europe has begun to implement it in the past five years. TRADE project will deploy a network of these instruments in the coastal strip of the Algarve and Huelva, and in the straits of Gibraltar (see figure). The area is selected because the maritime corridor located between Cape St. Vincent and the Strait of Gibraltar is the scenario of one of the world's largest vessel concentration. Many ships in the region are transporting oil, toxic products and chemicals. Additionally, in the coastal area that concerns the project, there are two national parks of high ecological value (Formosa and the Doñana). The TRADE project aspires to provide the technological infrastructure required by the region to prevent risks and, at the same time, substantially improve coastal management. To meet the general objectives described above, the following actions will be carried out: 1) Implementation of an HF Radar network for observation of surface currents and waves; 2) Establishment of the methods and procedures for validating the quality of information provided by the new infrastructure and integrate it into existing Puertos del Estado and Hydrographic Institute information systems and 3) - To create a platform for managing cross-border interoperability and distribution of data, as well as develop a model of collaboration that allows for joint management of information in a new model of trans-boundary ocean observatory. Results of the project will

be integrated in the framework of GMES, EUROGOOS, EMODNET and MyOcean activities.

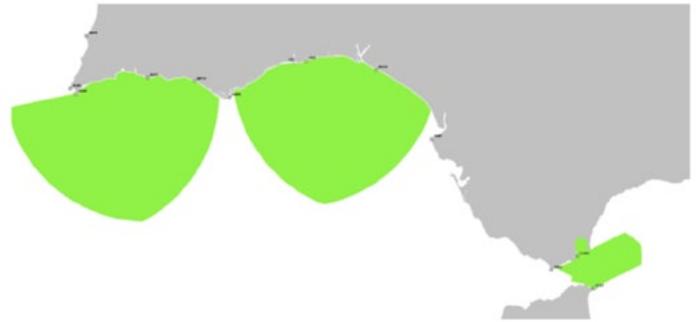
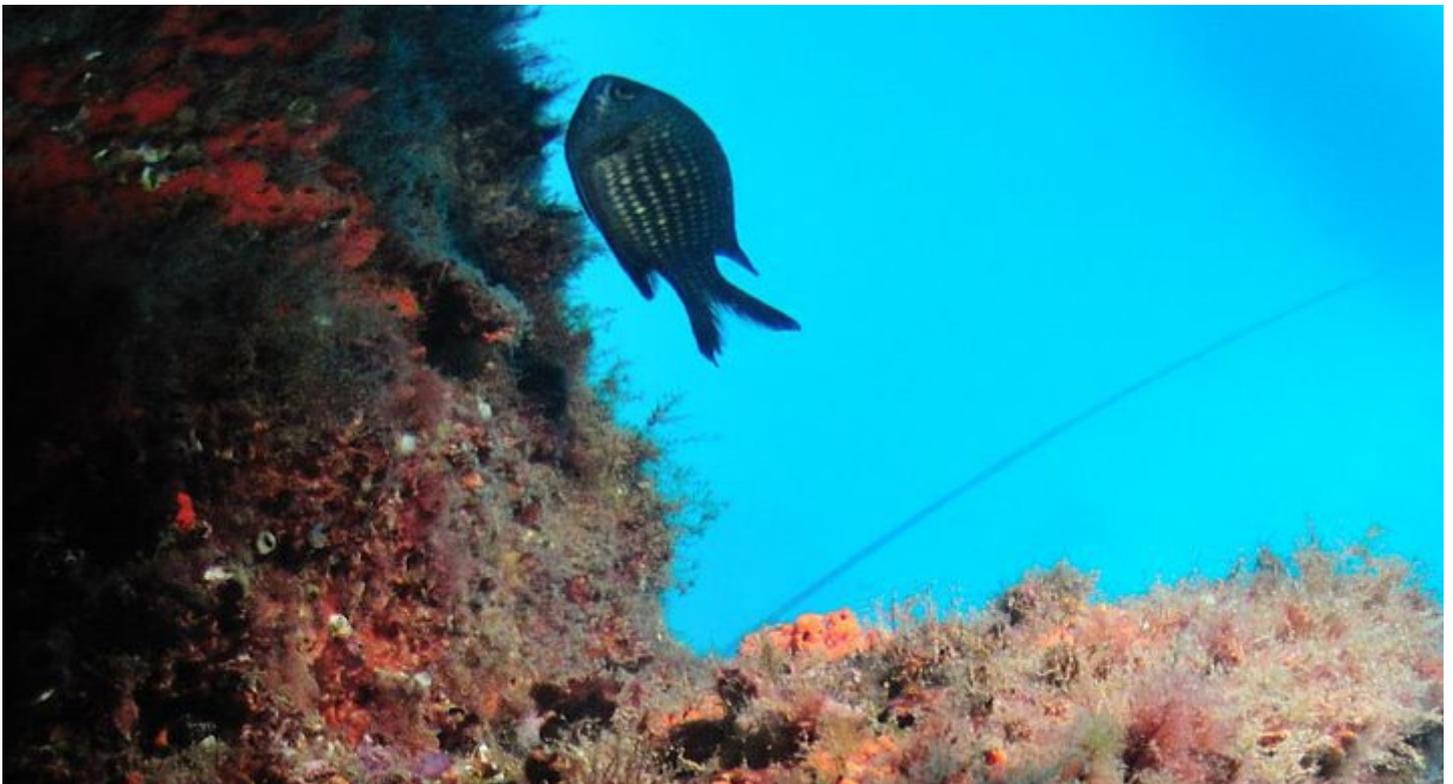


Figure 1: HF radar network for TRADE project



Underwater life. Picture by Ramon Margalef

HYDRODYNAMIC MODELLING AND OPERATIONAL OCEANOGRAPHY FOR OIL-SPILL EVENTS IN THE ANDALUSIAN COAST: A REAL CASE STUDY DURING THE FEDRA ACCIDENT (OCTOBER 2008)

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Abstract – The special hydrodynamic regime of the Andalusian Coast, the important meteorological influence, and the intense maritime traffic of oil tankers make the use of field measurements and appropriate hydrodynamic models to be an essential part of an operational system for the prevention and management of oil spills in these waters. An operational oceanography system has been developed, based on the use of different numerical models and field stations, whose results are implemented into an online GIS environment available to researchers and Institutions at a website, providing oceanographic information and prediction fields with different levels of time-spatial covering and resolution. A practical example during the oil-spill accident of the tanker Fedra at Algeciras Bay in October 2008 is given.

Keywords – operational oceanography, hydrodynamic modelling, oil spills, Andalusian Coast.

1. INTRODUCTION

The Andalusian Coast constitutes a physical environment of special characteristics, due to the presence of environments with different hydrodynamic conditions: the Gulf of Cádiz at the West (Atlantic Ocean), the Alboran Sea at the East (Mediterranean Sea), and the Strait of Gibraltar connecting them. The intense maritime traffic of oil tankers sailing across the Strait of Gibraltar, together with the presence of oil refineries at Huelva and Algeciras, imply high risks of oil spilling within these waters, and unfortunately it has constituted a matter of usual occurrence through the last decades. The Research Group "Physical Oceanography: Dynamics" of the University of Cadiz have developed a system of operational oceanography for all this area, based on the use of different hydrodynamic, meteorological, wind-wave and transport-diffusion models, as well as in situ data acquisition stations. Results are real-time implemented into an interactive GIS (Geographic Information System) environment available online to the concerning researchers and Institutions at a website, providing current hydrodynamic information and prediction fields. The system was applied to the real case of the oil-spill accident caused by the oil tanker Fedra inside Algeciras Bay in October 2008, which is presented as an example in this paper.

2. THE OPERATIONAL OCEANOGRAPHY SYSTEM FOR THE ANDALUSIAN COAST

The online GIS environment provides the time-spatial prediction fields of hydrodynamic properties based on the results of different numerical models: two-dimensional/depth-averaged (UCA 2D, [1]), two-dimensional/two-layer (UCA 2.5D, [2]) and three-dimensional (UCA 3D, [3]) hydrodynamic models, meteorological model (MM5, [4]), wind-wave model (modified SWAN, [5]), and transport-diffusion models [6], having different levels of spatial covering and resolution. In addition, an oceanographic buoy mooring is installed at Cadiz Bay, which is constantly measuring and transmitting via modem oceanographic data of surface elevation, currents, temperature, salinity, turbidity and chlorophyll concentration. These data are real-time implemented and recorded into the online GIS environment as a complement and validation of the model results. Similar field stations are planned to be installed in other points of interest throughout the Andalusian Coast. The resulting data of the precedent models and the field station are real-time implemented and recorded into an interactive online GIS environment, where the time-spatial fields of model results are graphically represented as well as the series from the buoy mooring. All these information are available at a website (<http://sunotri01.uca.es/client>) in a user-defined environment. The allowed researchers and Institutions are also able to download selected data series and time-spatial fields for scientific and social purposes. The 'default' contents of the GIS environment are the predictions and records from the hydrodynamic and meteorological models and the time series from the buoy mooring, whereas in case of a real oil-spill accident the requested results from the wind-wave and transport-diffusion models are also deployed.

3. A CASE STUDY: APPLICATION TO THE OIL-SPILL ACCIDENT OF THE TANKER FEDRA INSIDE ALGECIRAS BAY IN OCTOBER 2008

On 12th October 2008, the oil tanker Fedra wasted more than 150 tons of fuel into the Algeciras Bay waters, affecting the shoreline of these coasts. During the palliation and managing activities carried out for this oil-spill accident in the subsequent days, the described operational oceanography system provided the prediction of the time-spatial evolution of the spill for such period, considering the hydrodynamic and meteorological conditions present, as well as the nature, amount and location of the spill. In addition, the accident was used to validate the accuracy of the predictions given by the system, by comparing the calculated time-spatial fields with in situ photographs of the oil spill (Fig. 1). Results confirmed the ability of the operational oceanography system to predict the general evolution of the oil spill and the most affected coastal areas.

4. CONCLUDING REMARKS

An online GIS environment has been developed to integrate, host and represent the resulting oceanographic data from different models and field stations, available at a website and mainly focused on the establishment of an operational oceanography system for the Andalusian Coast. The scientific and social application of this system becomes a very useful tool for the monitoring, prediction and management of eventual oil-spill accidents in these waters, as demonstrated in the real case of the Fedra oil-spill accident. One remarkable advantage of the system is its ability to consider and assimilate data from other models, domains and field stations which could be developed in the future. However, it is still necessary to deep in the development of the best modelling and data analysis strategies in order to optimize the practical management of these accidents.

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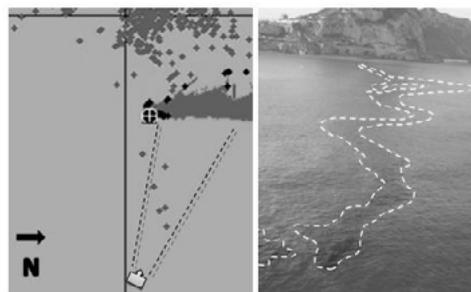


Figure 1. Example of comparison between the system prediction (left) and an in situ photo (right) for the Fedra accident.

POTENTIAL CARBON DIOXIDE FIXATION BY MARINE MICROALGAE *NANNOCHLORIS ATOMUS*

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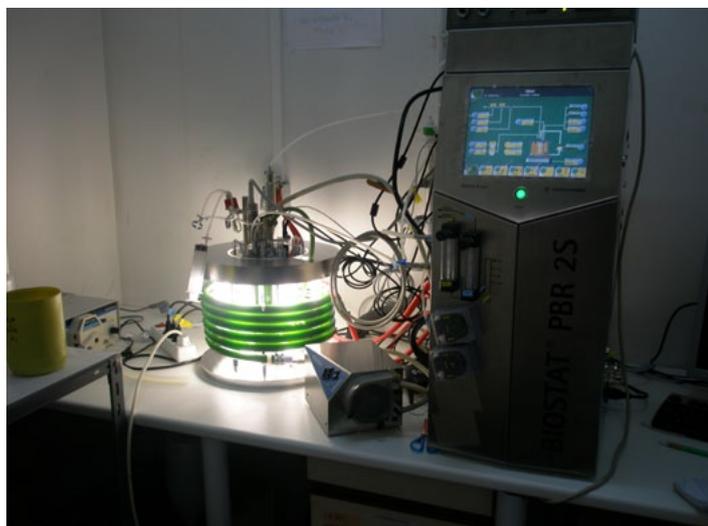
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Abstract - "The increase in the concentration of atmospheric carbon dioxide is considered to be one of the main causes of global warming. Microalgae can contribute to the reduction of atmospheric carbon dioxide by using this gas as carbon source. We cultivated *Nannochloris atomus* in a helical tubular photobioreactor. Potential carbon dioxide fixation was compared under different growth conditions.

Keywords - "Photobioreactor, carbon dioxide, microalgae.

A variety of studies investigating different strategies for CO₂ sequestration have been conducted since the 1990s, of which biological methods, in particular using microalgal biofixation in photobioreactors, have recently gained renewed interest [1]. The cultivation system consisted of a BIOSTAT[®]PBR 2S photobioreactor with a working volume of 3L (Fig. 1)



"Fig. 1." Photobioreactor system.

The strain belongs to a stock culture kept in our laboratory. The culture medium was a modified F/2 medium made in filtered sterilized natural seawater, without nutrient limitation. The cells were continuously aerated at a rate of 300 mL min⁻¹. The growth medium was controlled at different temperatures by the recycled water from a thermostatic bath, The mixing was driven by a peristaltic pump. Illumination of culture was provided by eight fluorescent lamps with 1200 lm per lamp. For control and measurement of pH, a sensor was used and the pH was controlled by automatic injection of CO₂. The cultivation vessel was coupled with the sensor for the CO₂ measurement in the inlet and outlet. In the inlet, CO₂ was monitored by a rotameter, while in the outlet, total flow was monitored by an infrared CO₂ gas analyzer (LI-6262 CO₂/H₂O Analyzer, Nebraska, USA). The maximum cellular density achieved in the experiment was of 1430•10⁶ cells mL⁻¹, with a cell mass of 2900 mg L⁻¹. Cell density values and linear regression were used to calculate the growth rate (k, d⁻¹) during the exponential phase, obtaining a value of 0.4971 d⁻¹ (Fig.2). Potential fixation was calculated as: $\Lambda = m f k \delta$, where Λ represents the CO₂ fixation rate (mmol C d⁻¹ L⁻¹), m represents cellular mass (g cell⁻¹), f represents the carbon fraction, k represents the growth rate, and δ represents cell density (cell L⁻¹). We calculated the potential fixation for the different averaged cell densities reached in each phase, obtaining a value of 51.3 mmol C d⁻¹L⁻¹ (pH 8.5 and temperature 20°C), 57.2 mmol C d⁻¹L⁻¹, (pH 8.0 and temperature 20°C), 58.8 mmol C d⁻¹L⁻¹, (pH 8.0 and temperature 25°C), 62.2 mmol C d⁻¹L⁻¹ (pH 7.5 and temperature 20°C).

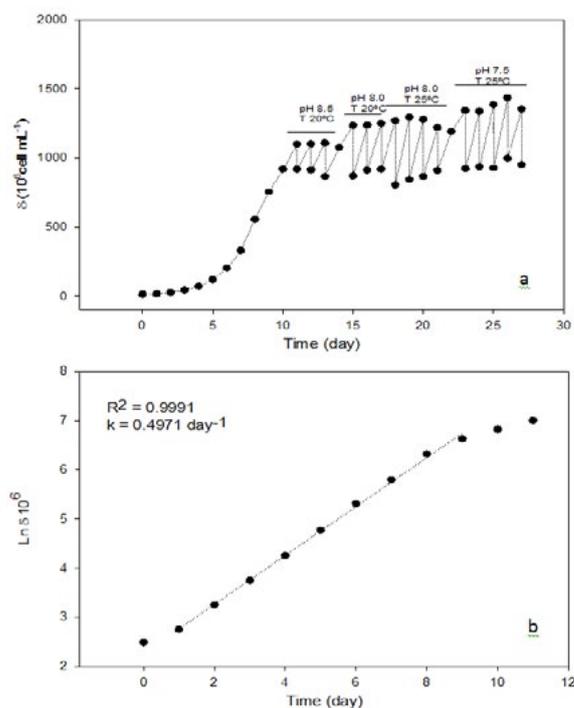
The maximum potential fixation such as cell density are reached with lower pH and a high temperature, due that *Nannochloris* species have a greater capacity for CO₂ utilization rather than HCO₃⁻ [2].

ACKNOWLEDGEMENTS

This study was supported by the Research Projects CICYT - CTM2008-04807 and PO7-RNM-03197.

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"Fig. 2." (a) Growth curve of *Nannochloris atomus* when submitted to different conditions of temperature and pH. (b) Linearization of the exponential growth phase for calculating the growth rate.

LD MANAGER AND LD TOOLS: NEW SOFTWARE TO OPERATE LAGRANGIAN DRIFTERS

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Abstract - The following article presents a new software whose purpose is to ease the operation of lagrangian drifters and the ulterior data retrieval. LD Manager relies on the use of TCP/IP communications between the drifters and the computer that runs this piece of software. It manages TCP connection requests from its clients, the drifters, and fills up a database with the information they sent. LD Tools is an easy-to-use interface that makes experiment organization and data retrieval much more efficiently.

Keywords - lagrangian drifter operation, TCP/IP communications

LD MANAGER

LD Manager is the piece of software that manages the communications with the drifters and that interacts with them under an eventual petition from the operator of the software. It has been developed in Java, and a successful beta version has been generated and tested for Windows XP and Windows 7.

As a background process, a TCP server runs in the computer where this software is installed. This process manages the connection requests from the drifters, establishes the appropriate TCP sockets and refresh the connections in case of IP change.

Figure 1 shows the flow of information between the server and the drifters. The data generated by the drifters is sent to the server via internet (orange path in figure 1). Therefore, the drifters must be equipped with modems able to implement TCP/IP telecommunications. These data is stored in a database in the computer along with some other relevant information as the current drifter configurations and so on.

Configuration change petitions (yellow path in figure 1) on the drifters can be handled by using an additional GSM modem. This modem send any configuration change request via SMS and waits for acknowledge from the drifter (blue path in figure 1).

LD TOOLS

LD Tools is an additional piece of software intended to organize lagrangian drifter experiments and ease the data retrieval.

Concerning experiment management, LD Tools allows creating, editing and archiving experiments. As a lagrangian experiment may involve one or more drifters, this software relies on a database to organize all that information in order to recover it later on.

Data retrieval may be done by focusing on the whole data set of a single drifter and then filtering the initial and final dates. However, the recommended data retrieval method is based on experiment identification. As an experiment has information on the drifters involved, the initial and final date of the experiments, data recovering with this method is usually faster and more accurate.

FIELD TEST

Successful tests have been performed in Spain (Gulf figure 2 –) and France (Ligurian Sea) so far.

FUTURE WORK

Further collaborations all around Europe and other Mediterranean countries must be established in order to get user feedback and enrich this software solution.

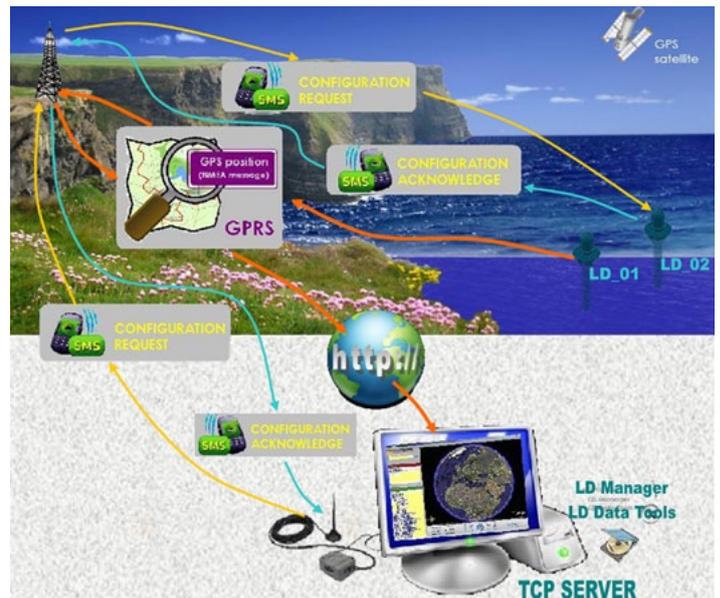


Figure 1. Information flow between drifters and the server running LD Manager.



Figure 2. One-drifter lagrangian experiments operated with LD Manager.

NEW LAGRAGIAN DRIFTER FOR COASTAL APPLICATIONS

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Abstract - The following article presents an innovative model of lagrangian drifter for coastal applications. Its geometry has been designed to improve three main aspects over other existing coastal drifters: maximizing experiment life, reducing the influence of the wind drag and maximizing its vertical stability. The electronics is also a non-conventional part of the design as it has not been designed on purpose, but it has been chosen from the big variety of GPS trackers existing in the market able to carry out GSM/GPRS communications with a server. This way of approaching the election of the electronics facilitates its accomplishment with industry and electronic standards.

Keywords - lagrangian drifter, GPS tracker, GSM/GPRS

The design of the new lagrangian drifter presented in this work has been approached from two sides: first, by electing an appropriate model of GPS tracker able to implement GSM/GPRS communications; and second, by designing a new float geometry able to solve some of the problems occurring in other type of coastal drifters.

THE ELECTRONICS

The electronics inside this new model of drifter has been meticulously chosen from the big variety of GPS trackers existing in the market. Advantages of this election are: first, this piece of electronics has been thoroughly tested at the factory, providing much more robustness to the solution compared to other existing drifters whose electronics has been developed ad hoc with no much time expending for testing, understandable fact since it is a very expensive part of the commercial product development chain; second, it has passed most of the industry quality controls accomplishing with electromagnetic radiation regulation; and third, it implements most of the necessary features for lagrangian water mass characterization.

As summary, the main requirements this piece of electronics must implement are: being able to send to a server some general NMEA commands containing the position and velocity of the device generated by the GPS modem inside it, being able to send status flags informing, for example, about the quality of the recorded data and also being able to inform about important events that can compromise the success of the experiment.

THE FLOAT

The float, made of special UV-proof polyethylene, is shown in figure 1. It consists of three main cavities, each of one aiming at a different purpose.

The lower cylindrical cavity encloses the heaviest elements of the drifter, i.e. the battery packs. Its length allows the center of gravity of the buoy to be further below from the flotation line than in some other the drifters in the market.

The second cavity, conical in shape, provides flotation to the drifter and stability against horizontal efforts like wind drag. All this vertical stability, keeping the antennas of the GPS tracker well-oriented most of the time minimizing bad GPS-fix points and improving the quality of the telecommunications signals.

The upper cylindrical cavity allows all the elements to be placed inside the float. It may be closed with a watertight lead and it encloses the GPS tracker with the antennas (GPS and GSM) keeping them at the top part of the float.

FIELD VALIDATION

In order to validate the design of the drifter, this model has been equipped with standard commercial drogues for swallow water characterization and its drifting behavior compared with the ones from some other widely-used commercial drifters. In particular, simultaneous deployments with a first-class commercial model (the Davis drifter, from Pacyfic Gire) have been performed to characterize the dynamics of the upper one-meter layer in a tidal channel reaching satisfactory results.

FUTURE WORK

Due to the fact that the submerged part of the buoy is bigger than in other

drifters, it may be possible to reduce the drag area ratio of the drogues that can be used, especially for swallow waters. One of the paths that currently is being explored is the design of smaller drogues that will still make the drifter to successfully follow the water parcel it is designed to (figure 2). In parallel, it is expected to progress in the design of especial drogues to optimize the drifter behavior for other applications as oil-spill or medusa bloom tracking.

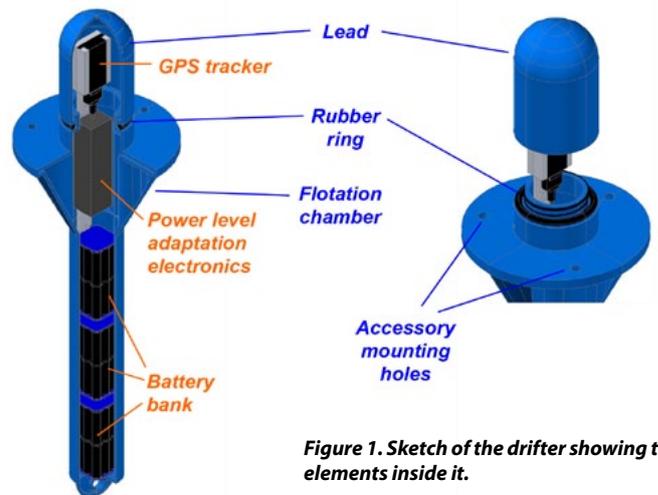


Figure 1. Sketch of the drifter showing the elements inside it.



Figure 2. Lagrangian drifter equipped with a Davis-type drogue centered at 1 m depth.

CO₂ BIOCAPTURE IN PHOTOBIOREACTORS USING MARINE MICROALGAE *NANNOCHLOROPSIS GADITANA*

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Abstract- All international commitments force a progressive reduction of carbon dioxide emissions to the atmosphere. Because the Andalusian coast is characterized for its high solar radiation index and temperature variation interval, it becomes a good place for the use of microalgae for this purpose. Therefore, the study of *N. gaditana* in function of its carbon dioxide capture capacity and biomass utility was chosen for the analysis of CO₂ capture in large intensive culture photobioreactors.

Keywords- Photobioreactor, CO₂ fixation, *N. gaditana*, marine microalgae.

The photobioreactors were specially designed to obtain cultures with high cellular densities with the possibility of realizing a continuous analyze of gas transfer between gas phase and water, this and other possible solutions applied for its control, make of this initiative a very innovative technology (Figure 1).



"Fig 1." Specially designed photobioreactors.

N. gaditana cultures were introduced in the photobioreactors with initial cellular densities of 7×10^6 cell mL⁻¹. This strain is characterized for a long lag phase period as shown in Figure 2; once the exponential phase was reached the CO₂ injections were followed (14 μ L/min). For each day of the assay, samples for cellular counting, biomass, organic carbon determination and inorganic carbon determination were collected. Also continuous data of control parameters such as dissolved oxygen, pH, temperature, light intensity, nutrients and CO₂ balance were stored in a PLC.

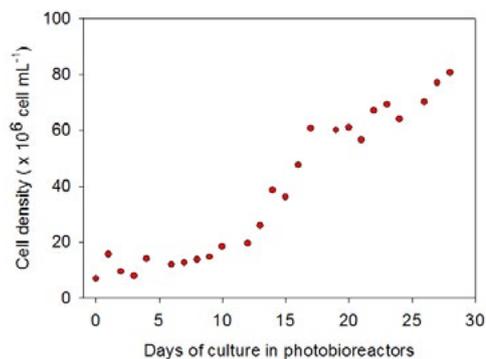


Fig. 2." Typical *N. gaditana* cellular density evolution.

During the assay clear capture of CO₂ by *N. gaditana* was observed. Inlet values of CO₂ concentration resulted always higher than the ones measured from the outlet of the reactor with variation differences from 100 to 300 μ mol mol⁻¹ (Figure 3).

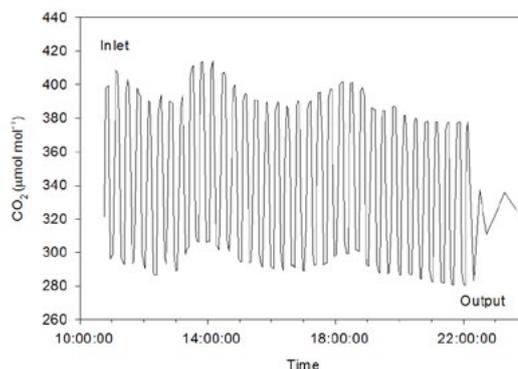


Fig. 3." CO₂ concentration variations between inlet and outlet of the photobioreactors

All these assays followed with this particular strain should be completed with other selection of marine microalgae to be able to stipulate which of them configure the best experimental conditions and result. Also, the main aim of this study is to be able to extrapolate these results obtained in laboratory conditions to industrial scale, the information obtained may be a very interesting tool to be able to establish the viability of microalgae as a proceeding to reduce the CO₂ emissions into the atmosphere due to industries situated near the coast.

ACKNOWLEDGEMENTS

This study was supported by the Research Projects CICYT - CTM2008-04807 and PO7-RNM-03197, and the MAEC-AECID grant 0000529328 (Programa Extranjeros II-A, 2010-2011).

HYDRODYNAMICAL MODELLING AS A TOOL FOR SCATTERED SHIPWRECK SITES IDENTIFICATION AND PROSPECTING: THE “FOUGUEUX” SITE CASE

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Abstract – A shipwreck site located in Camposoto beach (Cadiz, Spain) and containing 31 iron guns and a large anchor was protected and included in the General Catalogue of the Andalusian Historical Heritage in 2008. The archaeological remains relate it to the Battle of Trafalgar identifying it with the “Fougueux”, a Téméraire class 74 gun French ship of the line. Available information (including ships’ logbooks weather observations and other documents) establishes that a dismantled French ship ran aground on 22nd October 1805, and broke up into pieces on 25th due to tempestuous weather. Making use of all available information and of a set of numerical models (ocean circulation, meteorological and transport) we have simulated different scenarios in order to establish the most probable areas for finding the remains of the “Fougueux” accounting for the uncertainty of the available information. The relative contribution of the dominant oceanographic processes to the dispersion of the remains was evaluated as well. Those areas were surveyed in 2009 resulting in the discovery of 4 additional sites containing 35 guns and a large anchor whose characteristics and dating are similar to those of the previously known site. These additional sites are located closer to the coast forming an imaginary line parallel to it. The results of our study point out the potential of hydrodynamic modelling as a tool for identification and prospecting of scattered shipwreck sites.

Keywords – hydrodynamical modelling, shipwreck, underwater archaeology, Andalusian Coast.

1. INTRODUCTION

In maritime archaeology it is accepted that physical processes dominate site formation in the early stages [1], which is very evident in the case of highly energetic environments. Energetic indeed can be considered the Atlantic Andalusian Coast which comprises the Strait of Gibraltar and the Gulf of Cádiz. The gulf and the strait can be thought of being geographically divided by the meridian crossing the Cape of Trafalgar. It was precisely in the waters of the Gulf of Cádiz, a few miles South-West off the coast and close to the cape where the epic Battle of Trafalgar took place on 21st October 1805. Following the defeat of the Franco-Spanish fleet, the heavily damaged ships had to face a severe storm with strong winds and high seas from the South-West [2]. As a result, many of the damaged and/or dismantled ships drifted ashore where they were wrecked or ran aground. Such was the case of “Fougueux”, a Téméraire class 74 gun French ship of the line which according to the existing documentary evidence [3] ran aground between the 22nd and 23rd October and broke up into pieces on 25th October. The main “Fougueux” shipwreck site was known; it was protected and included in the General Catalogue of the Andalusian Historical Heritage in 2008. The site is located at Camposoto beach (Cadiz, Spain), about 1 km from the coast at 10 m depth and contains 31 iron guns and a large anchor along with other minor remains, corresponding mostly to the middle third of the ship (see Fig. 1).

2. HYDRODYNAMIC SIMULATIONS AND FIELD SURVEYS

Under assumption that the main site corresponded to the location where “Fougueux” ran aground and from where it was broken up into pieces, we used already existing ocean circulation and transport models ([4], [5]) to simulate ocean conditions resembling those taking place from 22nd to 29th October 1805. Knowing that the ocean circulation in this area is dominated by wind and tides, and having documentary information about the meteorological conditions during and after the Battle of Trafalgar and about the time of the “Fougueux” grounding, we used that information for prescribing the tidal and wind forcing in the simulations. Fig. 2 shows the dispersion pattern of a passive tracer released at the main site location under a SW wind of 20 m/s (gale force). The dispersion pattern clearly indicates a drift to and along the coast with a strong northward component, pointing out the areas with highest probability of find-

ing large remains from the “Fougueux”. In summer 2009 those areas were extensively surveyed by means of Side Scan Sonar imaging, high resolution magnetometry and in situ diving, resulting in the discovery of 4 additional sites containing 35 guns and a large anchor whose characteristics and dating are similar to those of the previously known site (Fig. 1) [6]. The location of the additional sites matches the modelling results, consistent with the main site as a tracer source and a SW gale force wind induced current and waves. Noteworthy, the additional sites are nearly aligned with the 8 m isobath at almost fixed distance of 400 m from the present coastline forming an imaginary line identified as the position of the coastline in 1805 [7]: Smaller pieces with shallower draft were able to drift almost to the shoreline.

4. CONCLUDING REMARKS

We have made utilized validated ocean circulation and transport models to simulate the dispersion pattern of “Fougueux” remains. The ocean circulation of the shipwreck area is determined mainly by tides and wind. Therefore, a precise timing of the accident (in order to properly establish the tidal conditions) and knowledge of the weather conditions at the earlier shipwreck stages are needed. Unfortunately for the ships and crews taking part in the Battle of Trafalgar, the came under an unusual severe storm from the SW after the end of the firefight. It was a storm of such unusual strength, that, fortunately for us, diverse documentary sources provide ample information on it. This allowed us to prescribe adequately the tidal and wind forcings obtaining a coherent dispersion pattern which has been validated by the findings of subsequent surveys. The results of our study point out the usefulness of hydrodynamic modelling as a tool for identification and optimization of resources in prospecting scattered shipwreck sites.

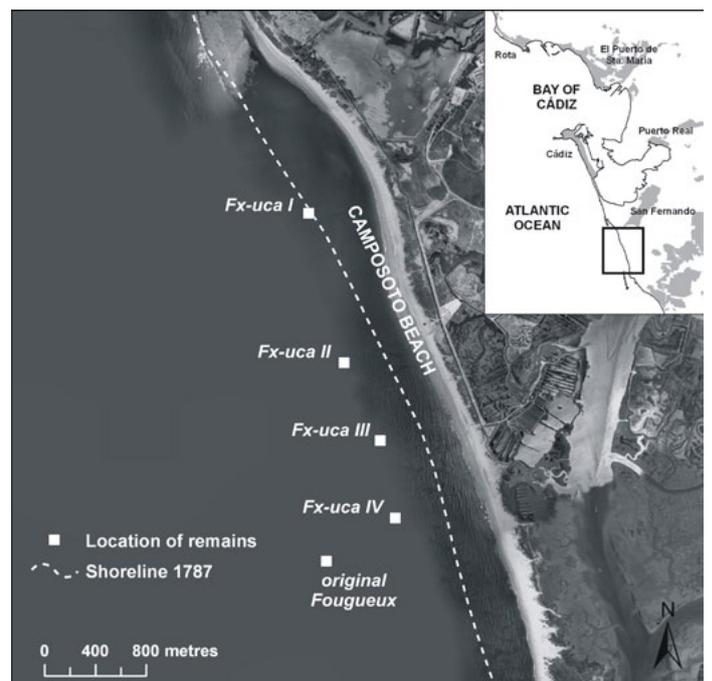


Figure 1. Location of the “Fougueux” archaeological remains on the basis of a 2002 orthophoto. Dotted line is the 1787 coastline, georeferenced with respect to Vicente Tofiño map (1787).

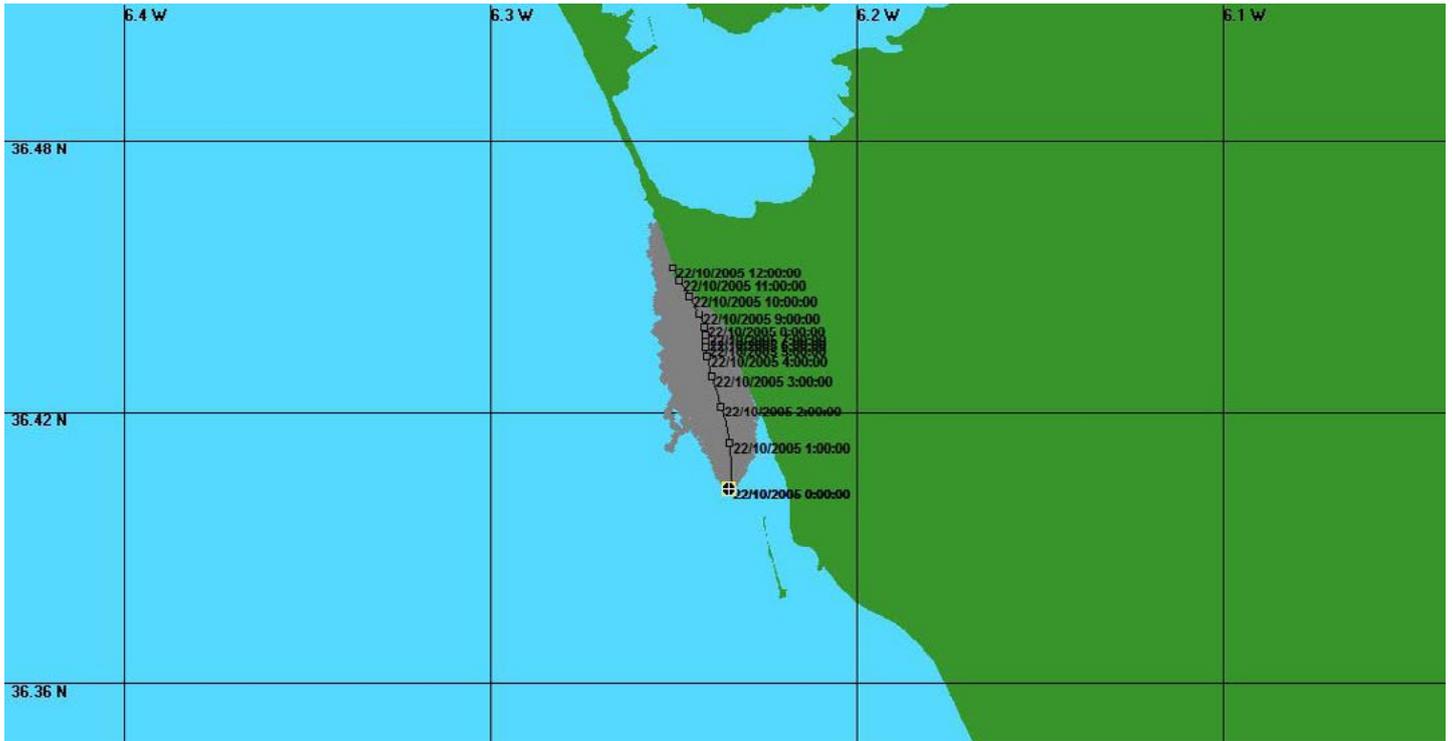


Figure 2. Dispersion pattern of a passive tracer released as a continuous source located at the main shipwreck site. The simulation was forced by a constant homogeneous wind of 20 m/s from the South-West.

ACKNOWLEDGEMENTS

This work has been supported by the Spanish Ministry of Science and Innovation Project CTM2010-16363.

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DEVELOPMENT AND AUTOMATION OF PHOTOBIOREACTORS FOR MICROALGAE INTENSIVE CULTURES FOR THE USE IN INDUSTRIAL GAS STUDIES

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"Abstract-" Although photobioreactors provide much more advantages over open cultivation systems, still more work has to be done in making them cost effective to set up and to operate than conventional pipe reactors and which give high algae yields. This study develops the design of two automation tubular photobioreactors of 550 L for intensive microalgae cultures.

"Keywords-" Automation of photobioreactors, microalgae intensive cultures, industrial gases.

The design of these, comprise two principal parts:

- An illuminated tubular part (Figure 1) connected to a degassing reactor by variable flow peristaltic pumps (up to 8000 L h⁻¹). This recirculation flow can be controlled and regulated by Electromagnetic Flow Meters. The illumination is followed by two panels with 126 specific LED focus for each of the two photobioreactors. Each one of these LED bulbs has a power of 12 W and consists of 138 red LEDs (650 nm) and 30 blue LEDs (420 nm). This provides useful photosynthetic light which does not generate heat and has a reduced energetic consumption. The illumination of these LEDs is externally controlled by radiance sensors and the intensity can be regulated.
- And the degassing reactors (Figure 2) which have a volume of 250 L and are aerated with gas compressors regulated by mass flow meters.

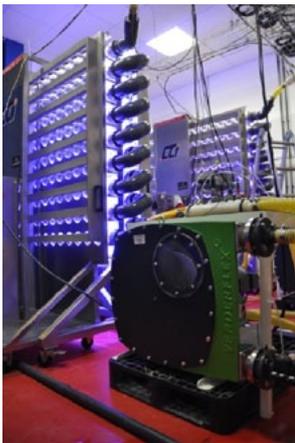


Fig. 1. Illuminated tubular part of the photobioreactor



Fig. 2. The degassing reactor.

Each of the photobioreactors are continuously monitored by two sensors of pH, oxygen and temperature (these are situated in the inlet and output of the illuminated part), and two turbidity sensors (which can be used as indicative of biomass). The idea would be to follow a fed-batch culture; therefore there is a continuous sample extraction which is replaced by the addition of nutrients and seawater by the use of peristaltic pumps. Also, the laboratory is thermostated and includes a system to filtrate and sterilize seawater (UV).

Once the samples are extracted they are filtered in line and the concentration of nutrients is determined in an automatic way by a nutrients analyzer, also in line. The injection of CO₂ and other possible gases, aim of the study, are injected by regulated mass flow meters. Gas concentrations of CO₂ and the other possible gases are analyzed, including the reference of gas added from by the gas compressors (inlet) and from the exit of the degassing reactor (outlet) to be able to establish balances (Figure 3).

All the system is controlled by a Siemens PLC, shown in Figure 4, which relate control values such as pH for example to injection of CO₂ and measured nutrients in samples to addition of these.



Fig. 3. On-line system of filtration of samples and analysis of nutrients and gases.

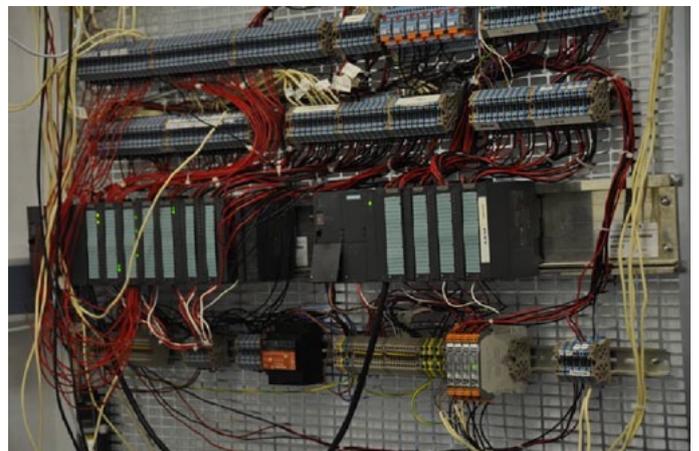


Fig. 4. Siemens PLC system for the automation of the photobioreactors

At this moment the two photobioreactors are operating with *Nannochloropsis gaditana* and *Tetraselmis chuii* and are resulting to be very effective and easy to control. The use of these photobioreactors allows a large amount of possible studies by the use of different microalgae strains and possible injection of industrial gases.

ACKNOWLEDGEMENTS

This study was supported by the Research Projects CICYT - CTM2008-04807 and PO7-RNM-03197, and the MAEC-AECID grant 0000529328 (Programa Extranjeros II-A, 2010-2011).

AUV-2011-UNDERWATER ROBOTICS EXPERIMENT IN THE MAR MENOR COASTAL LAGOON

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Abstract— As a result of the meeting held at SARTI in November 2010 (<http://sites2.upc.edu/~www-sarti/web/cat/meeting/meeting.php>) we are planning to conduct an AUVs experiment in order to determine the influence domain of the saltier plume of water going out the Mar Menor lagoon towards the Mediterranean Sea through The Estacio channel. This goal, besides the relevance to understand the influence of the lagoon on the Mediterranean Sea, offers the challenge of coordinating, for first time, a fleet of AUVs from different research institutions of Spain and Portugal. Experiments like this will follow in the future. These engineering and process oriented challenges are aligned along two primary and two secondary goals: 1) Primary goals: a) Deployment of a heterogeneous mix of mobile assets to densely sample a confined meso-scale area (< 50 Sq. km). While no lower bound on this number is envisioned, we expect at least 3 vehicles in the water simultaneously; b) Obtaining, interpreting and validating science data obtained by in-situ assets including AUVs; 2) Secondary goals:

a) Detection of prominent scientific features of interest in-situ by AUVs and b) Detection of such features using ship/shore based human-in-the-loop. A visible side-effect of these primary goals would also ensure that the participating institutions are able to cohesively work together to plan, launch and deploy assets and in the process understand the scientific drivers of the proposed field experiment. The AUVs planned to be involved in the experiment are: GUANAY II (SARTI, UPC), Sparus (U. of Girona), AEGIR (UPCT), SEACON and NAUV (LSTS, U. of Porto). An Slocum Glider (SOCIB) will also be involved.

Keywords – AUV, underwater robotics

I. INTRODUCTION

The Mar Menor is a large coastal lagoon in the Iberian Peninsula and one of the largest in Europe. It is an emblematic wetland on the RAMSAR sites list for conservation providing a large quantity of goods and services to the society. Many interests from tourism to fisheries to intense agriculture in the watershed to conservation, overlap the area. The economic value of fisheries, for instance, is substantially higher in the lagoon than outside.

A major program to monitor the lagoon is being funded by the Regional Government of Murcia as a strategic project in the Science and Technology Regional Plan. The "Campus Mare Nostrum", a joint venture of the Technical University of Cartagena and the University of Murcia, has been awarded as Campus of Excellence in the Spanish university System. This campus has the marine science and technology as one of the major challenge themes. Although the lagoon is important in itself, the SE coast of Spain is an area of large coastal oceanographic interest as shown in Fig. 1

The Mar Menor lagoon is located in a semi-arid region of Spain with evaporation exceeding precipitation and runoff thus providing its hyper saline character (45-47 PSU) and a range of temperature spanning from 10°C to 32°C seasonally. It has 135 Km² with 22 Km long (maximum distance) and 12 Km maximum wide with a maximum depth of 6 m and average of 3.5 m. With a volume of about 580 Hm³, its water renewal time is of 423 days (1.16 years approximately). The lagoon is separated from the Mediterranean Sea by a sand bar called La Manga. The exchange of water between the Lagoon and the adjacent Mediterranean Sea is carried out by three inlets (Fig. 2): Las Encañizadas to the North, The Estacio channel in the middle - throughout the main exchange of water occur - and Marchamalo inlet to the South.

Major forcing factors of water exchange are a horizontal pressure gradient due to difference in the sea levels (in and out of the lagoon) that are forced by tides (Fig. 3) - although very low -, atmospheric pressure (Fig. 4) and Ekman type transport of water piling up or retrieving water from outside La Manga. Winds action mixes the entered Mediterranean Sea water into the lagoon (Fig. 5).

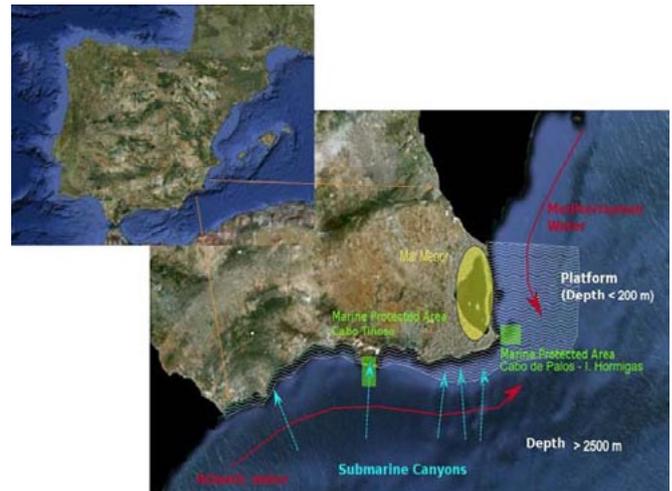


Fig. 1. Location of the Mar Menor lagoon and oceanographic singularities of the area.

To understand the capacity of the lagoon as a biological buffer, it is critical to understand the exchange of water between the Mediterranean Sea and the lagoon. Many species are not allowed to enter into the lagoon because of the strong environmental gradient, mainly imposed by salinity; but others, already adapted to the much more stressed lagoon environment, do leave the lagoon thus providing more resistant populations to changing environmental factors in the Mediterranean (e.g. by global warming trends). The lagoon is, from this point of view, seen as a natural laboratory to understand future changes in larger water masses. The stressed environment is also genetically selecting the species thus providing a reserve of biodiversity. Lagoon water going out to the Mediterranean Sea is, by itself, an important vector of exportation of selected species to the Mediterranean Sea.

To determine the three dimensional area of influence of the lagoon water in the Mediterranean Sea it is important to understand the propagation of the saline tongue leaving The Estacio Channel towards the Mediterranean Sea. Fig. 6 shows the results of a 2D advection -diffusion numerical model when more saline water is going out of the lagoon.

Validation of a 3D model of the saltier water tongue requires in situ simultaneous measurements in the area of influence in the three dimensions with the best available technology. AUVs are by now the most advanced technology available to this kind of measurements and can account for both spatial and temporal variations of water mass given their mobility. They are also cost-effective and adaptable to the changing environment in ways that traditional ship-based observations cannot.

II. SCIENTIFIC GOALS

The main scientific goal of the experiment is to determine the influence domain of the saltier tongue of water going out the lagoon through The Estacio channel towards the Mediterranean Sea.

This goal, besides the relevance to understand the influence of the lagoon on the Mediterranean Sea, offers the challenge of coordinating, for first time, a fleet of AUVs from different research institutions in Spain and Portugal. These engineering and process oriented challenges are aligned along two primary and two secondary goals:



Fig. 2. Inlets of the Mar Menor lagoon. North: The Encañizadas; Middle: The Estacio channel; South: Marchamalo inlet.

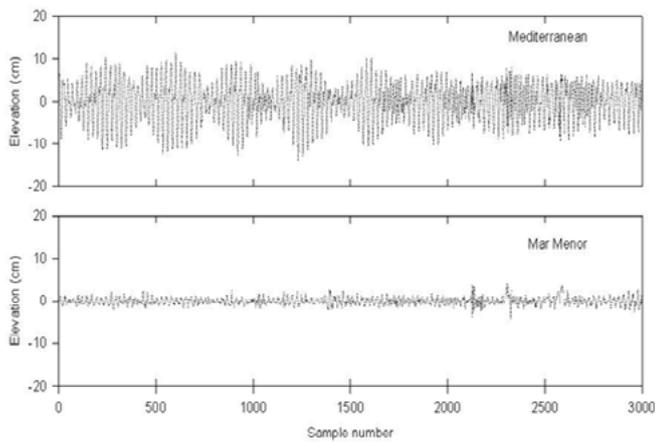


Fig. 3. Tides elevation in the Mediterranean Sea (Outside La Manga) and in the Mar Menor (inside La Manga), both in the vicinity of the main communication channel, The Estacio.

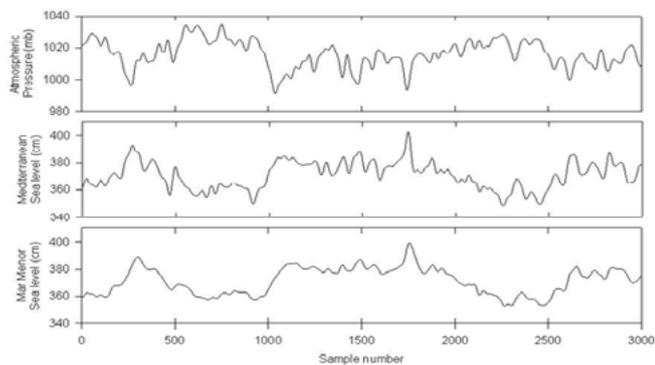


Fig. 4. Inverse barometric effect on the Mediterranean Sea and Mar Menor sea level.

A. Primary Goals

1. Deployment of a heterogeneous mix of mobile assets to densely sample a confined meso-scale area (< 50 Sq. km). While no lower bound on this number is envisioned, we expect at least 3 vehicles in the water simultaneously.
2. Obtaining, interpreting and validating science data obtained by in-situ assets including AUVs, ASV's, moorings or drifters, post-facto. Using this analysis

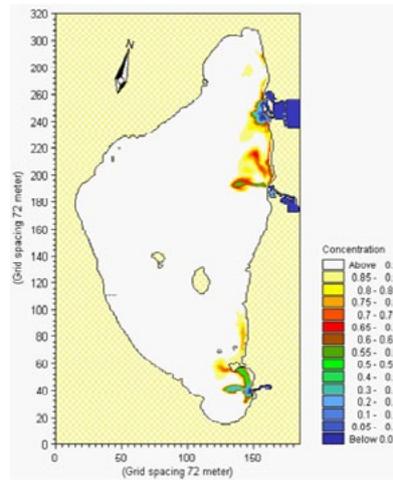


Fig. 5. Advection-diffusion numerical simulation of water exchange between the Mediterranean Sea and the Mar Menor lagoon. Dark blue color means 100%Mediterranean sea water, white color means 100% Mar Menor sea water.

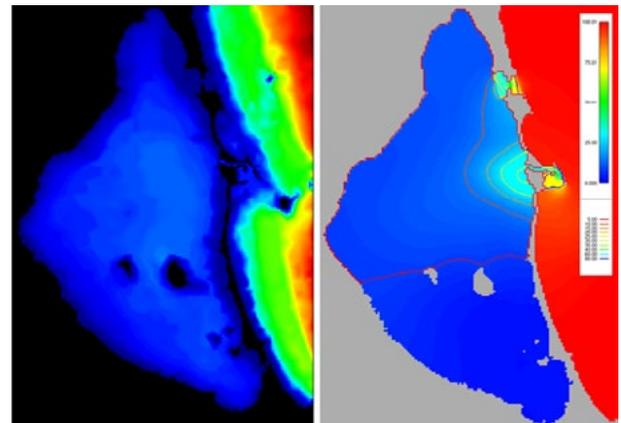


Fig. 6. Left: Bathymetry of the lagoon and the adjacent Mediterranean Sea. Maximum depth in the lagoon is 6 m, maximum depth shown in the Mediterranean Sea (red color) is 35 m. Right: 2D Advection-diffusion model output showing saltier water (about 75% lagoon water with 25% Mediterranean Sea water mixed, cyan color). Area of influence of the saltier tongue of water is marked by yellow/orange color in the figure.

to iteratively refine the sampling process using the above noted assets in the water.

B. Secondary Goals

3. Detection of prominent scientific features of interest in-situ by AUVs
4. Detection of such features using ship/shore based human-in-the-loop.

Our initial target would be to satisfy the primary goals, which will recursively require the need and deployment of a ship/shore-side data system and to synthesize the data products for scientific analysis. A visible side-effect of these primary goals would also ensure that the participating institutions are able to cohesively work together to plan, launch and deploy assets and in the process understand the scientific drivers of the proposed field experiment. Should the primary goals be satisfied early, we will attempt to go after the secondary engineering goals of enabling these assets to be more adaptive by virtue of sensing, detection and in-situ identification of scientific features of interest driven by local conditions at Mar Menor. Adaptation via control software or using aided human decision making tightly coupled with a vehicle future control actions would demonstrate an important science capability needed in the current generation of AUVs and ASVs.

A key outcome of this field experiment is to build a team (and consensus) towards working long-term in the Mediterranean as a viable research team to tackle interdisciplinary science and engineering problems. These goals are very aligned with institutions such as OBSEA, MBARI, SOCIB and future OOCMUR. Joint publications in peerreviewed journals and conference events will be critical to making impact and establishing such a working relationship in the long run.

III. EQUIPMENTS

The AUVs to be involved in the experiments are shown in figure 7: 1) GUANAY II - SARTI Autonomous underwater vehicle - Technological Centre of Remote Acquisition and Data processing Systems, Technical University of Catalonia (UPC), Vilanova. 2) Sparus – VICOROB: computer vision and robotics group – Department of Electronics, informatics and automatics, University of Girona. 3) ÆGIR – Underwater Vehicles Lab – Technical University of Cartagena. 4) SEACON and NAUV - Underwater Systems and Technologies Laboratory (LSTS), University of Porto. 5) Slocum Glider – SOCIB.

OBSEA & SOCIB will obtain data from all mobile and immobile (e.g any available moorings) assets as well as remote sensing data freely available for the Mar Menor region and to synthesize data products available to science for analysis. Temperature and salinity are two critical properties of seawater to be measured during the experiment. The lagoon temperature and salinity are different from that of the Mediterranean Sea. Although salinity is the main parameter to measure, it is also expected to find the saltier tongue of water going out the lagoon by measuring its temperature. Thus, all AUVs should be equipped with, at least, an external temperature sensor. AUVs equipped with ADCP, if available, would provide a detailed view of the currents and speed of the plume.

IV. STUDY AREA

It is expected that the saltier plume leaving the Estacio channel will likely move downward to the bottom, because of its higher density. Salinity maximum should depend of the flux of water going out the lagoon and distance from the mouth of the channel. Dominant winds in the area (>45% annual) are NE and Easterly. With these winds the plume should move to the South. However with SW winds (usually present in summer) the plume should move towards the North. Fig. 8 shows the area of interest for the experiment south to the Estacio channel together with a proposed set of AUV tracks to detect and measure the plume and its area of influence.

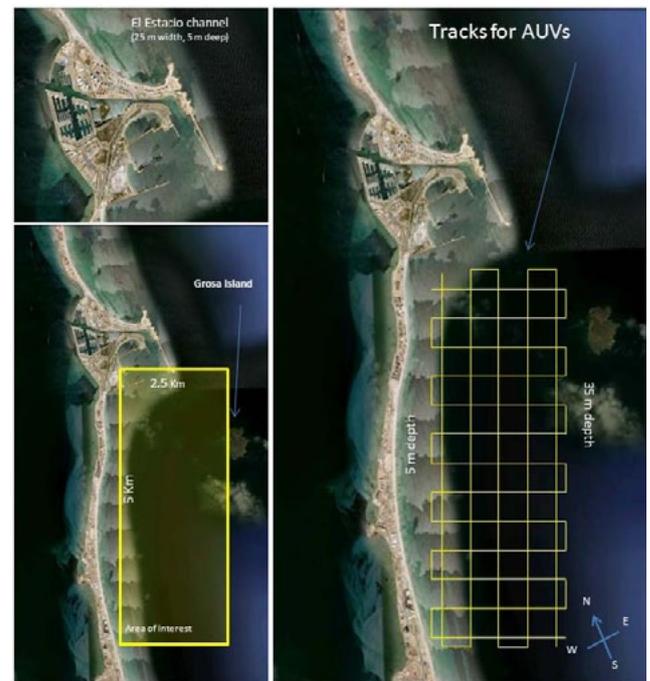
V. DEPLOYMENT STRATEGY

An early morning deployment would include a run of a TBD portion of the area of interest as shown in Fig. 8. Data returned from this run would be analysed approximately by 10am, by the entire team and a strategy for the deployments the remainder of the day would be articulated. Vehicles would then be deployed by the available support vessels and picked up by 4pm. Data is then uploaded to the data handling system and data products are analysed. Overnight missions where possible to record the impact of the diel-cycle on phytoplankton could be a potential extended experiment as long as safety considerations allow.

(right) Fig. 8. The Estacio channel (top left). Area of interest for the experiment (down left). Proposed track for AUVs matching the expected area of the saltier water plume.



Fig. 7: AUVs to be involved in the experiment



OPERATIONAL OCEANOGRAPHY APPLIED TO MARINE MONITORING AND ENVIRONMENTAL CONTROL IN HARBOUR FACILITIES. A PRACTICAL CASE

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Abstract – Operational oceanography applied to marine monitoring and environmental control in harbour facilities. A practical case.

Keywords – Operational oceanography, monitoring, environmental control.

INTRODUCTION

During the last decade, legislators have produced a legal framework for the environmental affairs, updating and adapting regulations to the industrial (particularly of the energy sector) and commercial activities. The introduction of the environmental crime figure in the Spanish regulations prompted the fixing of clear responsibilities to different actors. New obligations for industrial processes raised from this new legal framework and prevention of environmental problems instead of economic warnings were emphasized.

Nowadays it is generally accepted that the interaction between industrial activity and environment requires strategies, monitoring systems and effective control tools to mitigate possible hazards, particularly in highly pressured areas. A fine combination of oceanographic instrumentation, some knowledge on physical processes and operational oceanography are necessary to design and manage an effective surveillance system.

INNOVA oceanografía litoral, with the close involvement of the Laboratori d'Enginyeria Marítima LIM/UPC has designed, developed and installed a surveillance system for monitoring the sewage of an industrial process ending in the reintroduction of the processed water into the port of Barcelona harbour.

PROCESS DESCRIPTION

A volume of water is taken from the harbour of Port of Barcelona at 5-10 m depth to be introduced into two consecutive heat exchangers of the energy industry. The first process reduces its temperature in circa 6°C. The output of this first process is stabilized and is splitted into a main return volume (90% in volume) and in a secondary heat exchanger (freezing process) involving 10% of the original volume. This second process renders in a temperature increase of ca. 8°C, and salinity increase of ca. 50%. Some water is lost in evaporation, so only 70% of the secondary process is released, together with the main returned water, after a secondary mixing. The effluent should keep the original density of the incoming water to facilitate dilution.

THE S&T MONITORING SYSTEM

The industry located in the Port of Barcelona was required by the environmental office of the Barcelona Port Authority to implement an on-line operative system to control and response behind significant changes in the structure of the sea water.

To fulfil this requirements, a cluster of sensors have been deployed around the bottom driven effluent. One current profiler is intended to understand the dynamics of the water column and six CT sensors have been displayed around the effluent, at bottom (three instruments) and subsurface waters (1 meter bellow surface).

The aim of the monitoring system is intended for adjusting the relative volumes of the main and secondary volumes to ensure that the mixed returned water keeps the same density than the uptaken flow. In this way the dilution will be easily completed in a few tenth of meters from the effluent.

The system should be reliable concerning the measurement process (instrument quality and location); having almost real time access to the information for both the industry and the PA; customized data format according to PA standard; robust: traction and seawater resistant; and relocable: easy to move to other positions, in case of necessity.

The system is composed by one Doppler current profiler (Nortek Aquadopp profiler @ 1 MHz), six CT sensors (Valeport CT620 and miniCTs) and location pingers (Benthos ALP-365 EL). Six cables linking each instrument to a power autonomous outdoor cabinet (solar modules) and a LogComm device (Campbel CR1000 with GPRS comm. device) and auxiliary elements such as customized frames for instruments, cables and safety elements.

The system has been running from December 3rd sending 10 minutes bunches of data to 2 parallel receiving stations under hourly demands. Transfer and integration of acquired data in the port intranet has been performed successfully, while the industrial system operators get an on-line monitoring of the harbour water conditions.

Results show slight modification on the water densities that are detected only in the closer downstream CT sensors.



Fig.1 Outdoor cabinet showing solar module and acquisition/GPRS communication box.

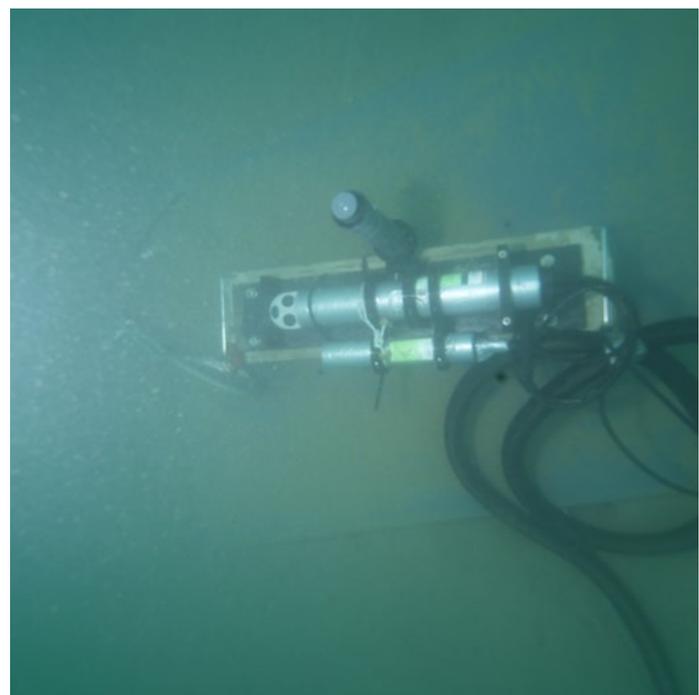


Fig.2 Aquadopp current profiler with CT probes and pinger on mooring frame.

JOURNAL AND COUNTRY RANKINGS IN INSTRUMENTATION AND OCEAN ENGINEERING

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Abstract - The purpose of this paper is to highlight scientific information resources that list journal and country rankings. These databases usually focus on the use of citation counts and number of publications to evaluate the interest, visibility and impact of research performance. The exposed resources are platforms that provide added value to authors improving their knowledge about research trends and also where to submit their papers.

Keywords - Journal rankings, Country rankings, Visibility, Citation analysis, Bibliometric evaluation, Journal performance

I. INTRODUCTION

This paper pretends to introduce the researchers and users of bibliographical databases to the journal and country rankings provided principally by two selected resources.

II. EXPOSED RESOURCES

Journal Citation Reports :

It's the most important ISI's analytical resource, using different metric tools like Impact Factor, Immediacy Index and Eigenfactor. Updated every year and covering data source from 1997, provides reports about almost 8.000 scientific journals previously indexed by *ISI Web of Knowledge*.



Fig. 1: Thomson Reuters JCR's logo

Research community members can evaluate and compare the impact and influence of these leading journals with different metric tools to decide, for instance where to publish his works and confirm the preferred journals status. JCR can show the most frequently cited journals, highest impact and largest journals in a field. In sum, serves to evaluate research output.

SCImago :

Open access resource retrieving data source contained in the already mentioned Scopus database. It's a result of the collaboration between Scimago Research Group and Elsevier and using the Google PageRank algorithm analyzes rank and compares scientific journals and country status.



Fig. 2: SCImago's logo

Provides users indicators like Scimago Journal Rank (SJR) and author's h-index calculated with the PageRank of the journals indexed by Scopus. Like JCR it's updated yearly but covers information from 1999 to the previous current year due to its open access condition. To search for the very current year users must consult Scopus database.

III. JOURNAL RANKINGS BY JCR

Next are listed the ranking of the first ten journals with greater impact, according to ISI 2010 data, distributed by four relevant Martech subject categories by ISI criterion too:

Category: Instruments & Instrumentation

Title	ISSN	Impact Factor	Quartile Rank
Laser physics letters	1612-2011	6.010	Q1
Applied spectroscopy reviews	0570-4928	3.686	Q1
Microfluidics and nanofluidics	1613-4982	3.504	Q1
IEEE Transactions on industrial electronics	0278-0046	3.439	Q1
Sensors and actuators b-chemical	0925-4005	3.368	Q1
Journal of instrumentation	1748-0221	3.148	Q1
Journal of synchrotron radiation	0909-0495	2.335	Q1
Journal of micromechanics and microengineering	0960-1317	2.276	Q1
Chemometrics and intelligent laboratory systems	0169-7439	2.222	Q1
Structural health monitoring-an international journal	1475-9217	2.115	Q1

Category: Ocean Engineering

Title	ISSN	Impact Factor	Quartile Rank
Journal of atmospheric and oceanic technology	0739-0572	1.860	Q1
Coastal engineering	0378-3839	1.624	Q1
IEEE Journal of oceanic engineering	0364-9059	1.402	Q1
Ocean engineering	0029-8018	0.954	Q2
Applied ocean research	0141-1187	0.859	Q2
Marine technology society journal	0025-3324	0.739	Q2
Journal of waterway port coastal and ocean engineering-asc	0733-950x	0.603	Q2
International journal of offshore and polar engineering	1053-5381	0.529	Q3
Coastal engineering journal	0578-5634	0.472	Q3
Marine georesources & geotechnology	1064-119x	0.452	Q3

IV. COUNTRY RANKINGS BY SCIMAGO

Next are listed the ranking of the first twenty countries with most publications, according to SCImago 2010 data, distributed by three relevant Martech subject categories by SCImago criterion too:

V. CONCLUSIONS

First, considering the ISI criterion about the way to divide the thematic categories, we can observe that some journals appears in various classifications, but in a different position, identified by the quartile, in his category rank. ISI's Impact Factor provide relevant information to authors about the importance of every journal and gives they some indication for were to publish their works. Second, observing the country ranks authors can see which countries are leading de research in similar thematic areas classified by Scimago. Country rankings calculates H index combining published documents and citations received in this documents. Taking into account the chosen categories, authors can observe the rank position of their preferred countries. Focusing the case in the ranking of Spain we can see that this country is relatively well positioned in Instrumenta-

tion and Oceanography but not much in Ocean Engineering. Finally and to conclude, these two resources can provide relevant data information to authors and help them make decisions for their research.

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Category: Marine Engineering

Title	ISSN	Impact Factor	Quartile Rank
Journal of navigation	0373-4633	0.691	Q1
Marine structures	0951-8339	0.594	Q1
Journal of marine science and technology	0948-4280	0.519	Q2
Journal of ship research	0022-4502	0.317	Q2
Marine technology and news	0025-3316	0.292	Q2
Proceedings of the Institution of Mechanical Engineers Part M - Journal of Engineering for the Maritime Environment	1475-0902	0.259	Q3
Naval engineers journal	0028-1425	0.138	Q3
Polish maritime research	1233-2585	0.114	Q3
Journal of marine engineering and Technology	1476-1548	0.087	Q4
Brodogradnja	0007-215X	0.037	Q4

Category: Oceanography

Title	ISSN	Impact Factor	Quartile Rank
Annual review of marine science	1941-1405	15	Q1
Oceanography and marine biology	0078-3218	8.571	Q1
Paleoceanography	0883-8305	4.030	Q1
Limnology and oceanography	0024-3590	3.385	Q1
Progress in oceanography	0079-6611	3.269	Q1
Marine chemistry	0304-4203	2.751	Q1
Dynamics of atmospheres and oceans	0377-0265	2.674	Q1
Marine geology	0025-3227	2.517	Q1
Marine ecology-progress series	0171-8630	2.483	Q1
Journal of physical oceanography	0022-3670	2.481	Q1

Category: Instrumentation

Country	Documents	Citations	H index
United States	22.495	174.620	114
China	14.531	29.264	45
Germany	11.079	95.518	86
Russian Federation	10.952	40.534	57
Japan	9.599	64.713	62
Italy	7.316	48.128	61
United Kingdom	6.857	56.198	73
France	6.220	52.572	66
Switzerland	3.767	39.273	64
Canada	2.995	24.835	57
Netherlands	2.437	23.356	62
Spain	2.297	18.471	45
Australia	1.905	15.274	44
India	1.904	12.362	30
South Korea	1.861	12.407	42
Sweden	1.833	16.968	53
Poland	1.822	14.100	47
Belgium	1.818	16.365	48
Brazil	1.625	8.453	31
Taiwan	1.542	12.284	42

Category: Ocean Engineering

Country	Documents	Citations	H index
United States	7.584	48.643	69
China	6.281	5.855	21
Japan	3.660	8.199	29
United Kingdom	3.008	11.854	39
Germany	2.285	5.347	29
South Korea	1.992	3.085	21
France	1.570	5.922	31
Norway	1.459	3.012	24
Taiwan	1.370	2.899	19
Canada	1.232	6.012	33
Australia	980	5.337	30
Italy	918	5.210	32
India	814	1.997	19
Netherlands	808	3.622	27
Turkey	805	2.104	18
Brazil	706	1.092	15
Croatia	664	240	6
Russian Federation	467	958	14
Portugal	434	1.862	21
Spain	405	2.299	25

Category: Oceanography

Country	Documents	Citations	H index
United States	43.409	769.620	192
United Kingdom	11.098	162.155	110
Germany	8.895	146.145	112
France	8.356	139.916	116
Japan	7.436	84.406	88
Canada	6.983	106.210	105
Australia	6.028	71.681	86
Russian Federation	5.388	29.605	58
China	4.636	30.609	60
Spain	3.987	44.085	66
Italy	3.958	49.519	76
Netherlands	3.311	55.662	81
Norway	2.638	34.452	65
India	2.169	12.860	43
New Zealand	2.089	25.913	57
Sweden	2.053	30.994	63
Taiwan	1.982	12.998	45
Brazil	1.700	17.189	52
Belgium	1.695	24.277	61
Denmark	1.672	27.896	67



NOTES



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organization:



sponsors:



collaborators:

