SENSOR INTEROPERABILITY IN THE FRAMEWORK OF OCEAN OBSERVATORIES

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1. Introduction

The establishment of permanent ocean observatories is a promising approach for monitoring the ocean interior in particular in regard to detecting the advent and consequences of sudden changes on the environment. From a technical perspective it is important to assure a seamless integration of all the needed subcomponents into the system. This is in particular of importance for the front end of the system, the sensors and instruments to be integrated.

Enabling sensor interoperability by introducing standards is a completely new concept in ocean sciences as there has been no real need for it in the past. Just to be able to deal with the anticipated complexity of the observatory structure standardisation has been recognized as indispensable.
Currently a number of technical groups have been established as part of the ongoing ocean observatory initiatives where according projects are running in Europe (ESONET), North America (NEPTUNE, MARS) and Japan (DONET,ARENA).

On top of the technical issues it will be of utmost importance to come up with a coherent standardisation and interoperability concept that can only be achieved by a close cooperation between all ongoing initiatives.

2. Results and Discussion

The aim of the interoperability activity is to come up with a general process model of the measuring process. This has already been started as part of the development of the SensorML content standard. In its simplest implementation SensorML is used to define standard digital methods of providing specification sheets for sensor components and systems.

In a next step it is necessary to judge about the quality of the data where a clear definition of the factors that influence the measurement process should exist (see fig 1).

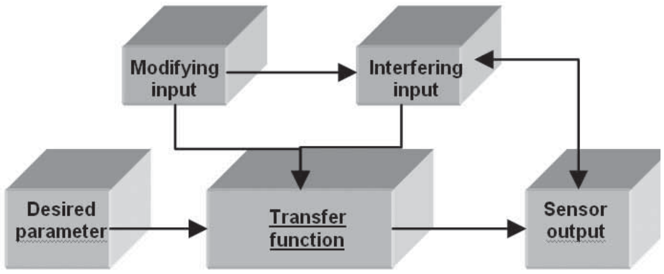

Figure 1: Generalised sensor scheme

All the information that describes the measuring process has to be made available in a standard format to make it possible to further process the data with different, user specific evaluation schemes. This also implies that the measured data that ocean observatories make available are interoperable which in this case means that at a certain stage of the data processing chain web services are forming the interface between the user and the individual sensor system.
This paper will give an overview about the current status in this field.

3. Acknowledgment

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4. References

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DEVELOPMENT AND TEXT OF THE DELFIMX CATAMARAN

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This talk will present the DELFIMx catamaran that is an autonomous surface craft developed at ISR/IST for automatic marine data acquisition and to serve as an acoustic relay between submerged craft and a support vessel. The talk will describe the navigation, guidance, and control systems of the vehicle, together with the mission control system that allows end-users to seamlessly program and run scientific missions at sea. Practical results obtained during sea tests in the Sines, Portugal will be briefly summarized and discussed.

Marine biologists and researchers depend on technology to conduct their studies on time and space scales that suit the phenomena under study. Several oceanography missions can be performed automatically by Autonomous Surface Craft (ASC), like bathymetric operations and sea floor characterization. ASC vehicles not only serve research purposes but can also be used for performing automatic inspection of rubblemound breakwaters, as required by the MEDIRES project. In the scope of this project, the autonomous catamaran DELFIMx, built

at IST-ISR, was used for automatic marine data acquisition. The vessel is a major redesign of the DELFIM Catamaran, developed within the scope of the European MAST-III Asimov project that set forth the goal of achieving coordinated operation of the INFANTE autonomous underwater vehicle and the DELFIM ASC and thereby ensuring fast data communications between the two vehicles.
The DELFIMx craft, depicted in Figure 1, is a small Catamaran 3.5 m long and 2.0 m wide, with a mass of 320 Kg. Propulsion is ensured by two propellers driven by electrical brushless motors.

Figure 1. The DelfimX Vehicle

The maximum rated speed of the vehicle with respect to the water is 7 knots. The vehicle is equipped with on-board resident systems for navigation, guidance and control, as well as mission control. Navigation is achieved by integrating motion sensor data obtained from an attitude reference unit and a DGPS (Differential Global Positioning System). Transmissions between the vehicle, its support vessel or the control centre installed on-shore are achieved via a serial radio link. The vehicle has a wing shaped, central structure that is lowered during operations at sea. At the bottom of this structure, a low drag body is installed that can carry acoustic transducers. For bathymetric operations and sea floor characterization, the wing is equipped with a mechanically scanned pencil beam sonar and a sidescan sonar, and a ladar for topographic surveys. The paper addresses the design of a laser range finder based coast line following controller to provide DELFIMx with the capability of safely performing automatic inspection of rubblemound breakwaters as is required by the MEDIRES project.

SEAFLOOR OBSERVATORIES, BENEFITS FOR THE MARINE AND EARTH SCIENCES. INTERNATIONAL AND EUROPEAN PERSPECTIVES TOWARDS NETWORKS

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1. Introduction

It is widely recognised that seafloor observatories offer Earth and Ocean scientists new opportunities to study multiple, interrelated processes over time scales ranging from seconds to decades. Scientific processes with various time scales should benefit from data collected by seafloor observatories, including episodic processes (such as volcanic eruptions, earthquakes, or biological, chemical and physical impacts of storm events); processes with periods from months to several years (like hydrothermal activity and biomass variability in vent communities); global and long-term processes (such as the role of the ocean in Climate). The establishment of an observatory network will be essential to investigate global processes, such as the dynamics of the oceanic lithosphere and thermohaline circulation.
This paper describes the State-of-the-Art of the seafloor multidisciplinary observatories, with particular emphasis to the European experience. The benefits of the multidisciplinary approach for the Marine and Earth Sciences are also discussed through some relevant examples.

Finally the perspectives at International and European level are depicted towards the establishment of "permanent" submarine networks particularly addressed to the study of seafloor and water-column processes.

2. Technical solutions for seafloor observatory architecture

The principal characteristic of a seafloor observatory is a two-way communication between platforms and instruments and shore. Seafloor observatories are characterised by the following basic elements: a) multiple payload; b) autonomy; c) capability to communicate; d) possibility to be remotely reconfigured; e) accurate positioning; f) data acquisition procedures compatible with those of shore observatories.

It is useful to introduce some definitions [1]:
Seafloor observatory is an unmanned platform, capable of operating in the long-term on the seafloor, supporting the operation of a number of instrumented packages related to various disciplines. Seafloor observatories can have as possible configurations: 1) autonomous, 2) acoustically linked, and 3) cabled:

1) autonomous, observatory in stand-alone configuration for power, using battery packs, and with limited capacity of connection, using, for instance, capsules or an acoustic link from the surface, which can transfer either status parameters or a very limited quantity of data;

2) acoustically linked, observatory able to communicate by acoustics to an infrastructure, such as a moored buoy or another observatory;

3) cabled, observatory having as infrastructure a submarine cable (retired cables, dedicated cables or shared cables devoted to other scientific activities, such as neutrino experiments).

Infrastructure is any system providing power and/or communications capacity to an observatory (e.g., a submarine cable, a moored buoy, another observatory); an infrastructure may also serve as support for other instrumented packages.

Instrumented package is a sensor or instrument devoted to a specific observation task; it may be hosted inside the observatory, be operated autonomously, be directly connected to an infrastructure or be