PROGRAMA DE DOCTORAT EN ENGINYERIA ELECTRÒNICA UPC-UIB

CURSOS i SEMINARIS DE FORMACIÓ DOCTORAL – CURS 2011-2012

SHORT COURSE: **MARINE SENSOR NETWORKS**

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PROGRAM:

DAY1: 17 de Abril, 10:00 – 14:00h, Sala de reuniones del Centro Tecnológico de Vilanova I la Geltrú (rambla Exposició, 24; http://maps.upc.edu/)

- **Introduction: Marine and submarine instrumentation (2 hours)**

General lecture based on instrument such as: profilers, gliders, drone (USV), buoys network, OBS, pore pressure sensor....

- **Marine Sensor Networks (MSN) development 1/2 (2 hours**)

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.

This talk/exchange is divided into 3 parts:

- Introduction & non-cabled observatories ESONET/EMSO: Introduction, architecture comparison, non-cabled observatories i.e. buoy based observatories. Example: Momar experiment

- Cable Sea Bottom Observatories ESONET/EMSO: Services, general design overview, technical description, interfaces, compatibility & interoperability, network extension.

- MeDON project: General design, architecture, specifications and comparison with OBSEA & OBSEA2

We describe in this last session 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.

DAY2: 18 de Abril, 10:00 – 14:00h, sala de reuniones del Centro Tecnológico de Vilanova I la Geltrú (rambla Exposició, 24; http://maps.upc.edu/)

- **Marine Sensor Networks (MSN) development 2/2 (2h**)

Continuation of the previous day.

- **Precision Time Protocol IEEE Std, 1588 in Marine Sensor Networks (1 hour)**

In this session we will present the interest of using the same timebase in Marine Sensor Networks. A comparison between time stamping services, time synchronization and timekeeping solutions will be presented.

The use of the IEEE Std. 1588 standard in Ocean Observatories. The setup and performance tests in underwater cabled observatory with a Master Clock synchronized with GPS, located in an on-shore station, and with underwater instruments requiring high precision PPS (pulse per second) signals for synchronization purposes will also be presented.

- **The Smart Sensor Board version 2 (1 hour)**

Marine instruments commonly use RS232/RS422/RS485 as a communication interface to be connected with an observatory. The possibility to enhance the instrument capabilities and make it smarter is the objective of this talk. Ifremer has been working in a preliminary hardware design of the smart sensor module, which has the capability of converting serial interface data into a low power Ethernet interface by adding several services such as: clock synchronization, time stamping, data logging, embedded instrument driver…. This way, all serial instruments (90% of the marine sensors) will be accessed through Ethernet protocol. At Technical University of Catalonia, the IEEE1451 and IEEE1588 had been evaluated

in order to be applied to marine instrumentation. Both works will contribute to the design of this module, which will provide IEEE-1451 output data for standardization and interoperability.

DAY3: 19 de Abril, 12:00 – 14:00h Sala de Actos de la Escola Politècnica Superior d' Enginyería de Vilanova i la Geltru (EPSEVG; Avda. Víctor Balaguer, 1; http://maps.upc.edu/)

Ifremer Research Institute (2 hour)

In the late 1990s, Ifremer, recognized the bright future for observatory science. Increasingly, the oceanographic community acknowledged that expeditionary research should be augmented by a new strategy of observatory research for a number of reasons. First, oceanographic processes are dominated by short-lived events: nutrient injections, plankton blooms, storms, earthquakes, etc. that are rarely captured during a research expedition. Second, the expeditionary mode of data collection is poorly suited to providing complete, comprehensive, and interdisciplinary data over long time periods, yet this is exactly what is needed to understand complex ocean systems. Despite the fact that there was wide agreement on these points, in the late '90s the oceanographic community was still in no position to implement observatory-style research, in which instruments and platforms are deployed long-term and collect data continuously.

This presentation will give an insight into our last developments in marine and submarine instrumentation including Marine Sensor Networks (MSN):

- Buoy based observatories

- Cabled observatories

- Specific instruments for cabled observatories

- Machine-To-Machine (M2M) architecture in oceanographic instruments: Unmanned Surface Vehicle (USV or Drones), surface buoys networks

- Subsurface profilers