

3. Communications subsystem

The measurement system developed doesn't have a human user interface. It can be controlled locally through an RS232 interface or remotely using several platforms (i.e. PC, PDA, etc.). The designed client/server architecture is composed by three types of elements, joined through the Internet as shown in figure 2: measurement systems, a name server and the clients.

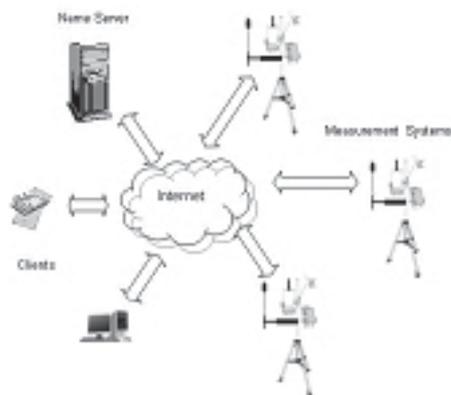


Figure 2. System architecture.

Measurement systems are connected to the Internet by means of a GPRS MODEM. During the initialization process each system registers itself in a name server. It then waits for a client to establish a connection. The name server is used to maintain a list of all the operative systems. Each system name is linked with its IP address. This is important because the Internet provider assigns dynamically a different IP address during system start-up.

The third element consists in one or more clients. To connect to a measurement station, each client needs to know its IP address. So first, the client requests the desired system's IP address to the name server. Once the client receives the IP address, it establishes a direct connection with the measurement system to obtain the stored measurements, get measurement results in real time and/or configure it. To be able to send and receive data through the Internet, it has been necessary to implement in the measurement system the net IP protocol and the transport TCP and UDP protocols. Furthermore the PPP protocol has also been implemented to negotiate with the Internet

provider the connection parameters and to obtain the IP address. The PPP protocol includes the link protocol HDLC. The implemented protocols are arranged conforming to the classic layered protocol stack structure, as shown in figure 3. This organization allows each layer to offer services to its upper layer while using the services provided by its lower

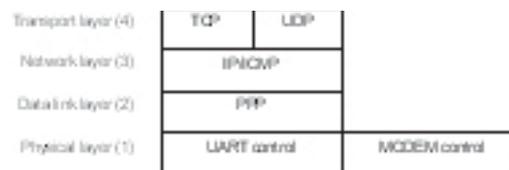


Figure 3. Implemented OSI levels.

It's important to observe that although the physical layer is managed by a GPRS MODEM, the communication with it is done using the DSP's internal UART.

4. Conclusions

To verify the functionality of the equipment a measure environmental noise system has been implemented. The system measures the next parameters:

- Noise with different frequency weighting (A, B, C and Z) and three time weightings (Fast, Slow e impulsive).
- Wind direction and velocity.
- Temperature.
- Humidity.
- Atmospheric pressure.

A TMS320VC5501 fixed point DSP has been used to minimize the system's power consumption. Thereby all mathematics operations have been adapted to fit the desired precision (24 bits). The system works in real time with a 2.3 Mbits conversion rate and an input margin range of 100 dB. Due its low power consumption the system is suited to work in insulates places to monitoring different parameters.

5. References

- [1] ETSI; "General Packet Radio Service (GPRS)", Service description, Stage 1(GSM 02.60 Ver. 6.3.0 Rel. 1997). October 1999.
- [2] RFC768; "User Datagram Protocol", Information Sciences Institute. August 1980.
- [3] RFC793; "Transmission Control Protocol", Information Sciences Institute. September 1981.
- [4] López J.M., at all. "Software architecture for an analyzer sound level meter DSP-BIOS.

THE ACOUSTIC OCEANOGRAPHIC BUOY: A VERSATILE ACOUSTIC DATA ACQUISITION SYSTEM

C. Soares, F. Zabel, C. Martins, A. Silva and S. M. Jesus

*C. Soares, F. Zabel, C. Martins, A. Silva and S. M. Jesus
Institute for Systems and Robotics, Universidade do Algarve,
Campus de Gambelas, 8005-139 Faro, Portugal.
Telephone: +351 289 800 949
e-mail: csoares@ualg.pt*

I. INTRODUCTION

The Acoustic Oceanographic Buoy (AOB) is a light underwater acoustic data acquisition system, which uses a surface buoy and an underwater vertical array of acoustic and non-acoustic sensors [1], [2]. The surface buoy includes a digital storage unit for the acquired data, a communications system for remote monitoring and data transmission, a digital processing unit for pre-processing of acquired data and a battery power supply, and GPS antenna for positioning recording and monitoring. The communication system allows for easy integration of the buoys in a computer network using standard network protocols. The AOB was developed under the AOB Joint Research Project, which was proposed in a consortium of several institutions, aiming at the development and validation of acoustic-oceanographic remote

sensing systems and data inversion-integration methods for the reliable, rapid environmental assessment (REA) of shallow water areas. The AOB is currently in its second version and two exemplars of this version were constructed.

II. EXPERIMENTAL RESULTS

This paper gives an overview of the hardware and software used in the AOB, and points out its versatility since it has been tested in a wide range of applications covering ocean acoustic tomography and environmental inversion, underwater communications, and underwater acoustic barriers. The number of sea trials involving the AOB in the last years is remarkable. The first version was used during the Maritime REA '03 (Mediterranean) and '04 (Atlantic) sea trials, and the



second version has been used in the MakaiEx'05 (Pacific), Blue-Planet'07 (Mediterranean), RADAR'07 (Atlantic), and UAB'07 (Hopavagen Bay and Trondheimsfjord) sea trials.

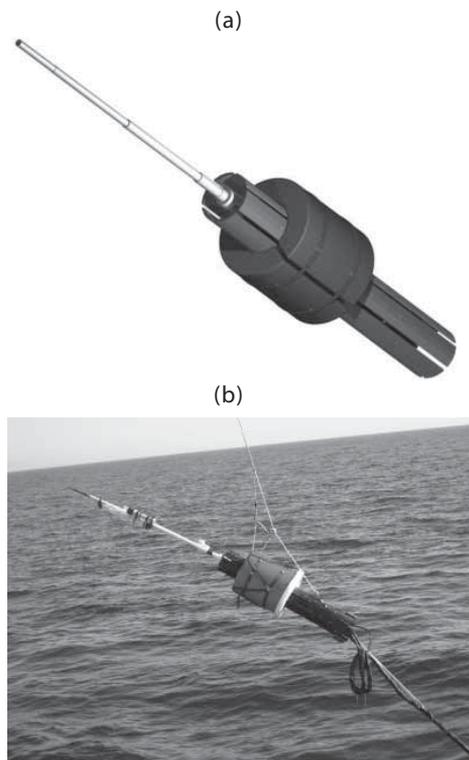


Figure 1. Acoustic Oceanographic Buoy: drawing from CAD software (a); deployment (b).

The first version of the AOB has been used in the MREA'03 [3], [4] and MREA'04 [5] sea trials mainly for ocean acoustic tomography and geoacoustic inversions at low frequencies. The second versions of the AOB has been used in high frequency acoustics for tomography and underwater communications in the MakaiEx'05 [6] and the RADAR'07 sea trial.

In recent sea trials two scientific concepts such as real-time network tomography (BluePlanet'07 and RADAR'07) and underwater acoustic barriers (UAB'07) that explore the AOB's characteristics were tested. The former application requires communication facilities and operability in equipment deployment and recovery, since at least two receiving equipments must be used. The latter requires communication facilities since the received signals have to be immediately transmitted to the platform holding the acoustic source, time-reversed and retransmitted back to the receivers.

III. CONCLUSION

Throughout the past four years, the AOB has demonstrated to be handy, allowing for several deployments in each sea trial, and was used with success in a wide range of applications, and have operated as a service to the international underwater research community in relevant number of sea trials.

REAL-TIME ENVIRONMENTAL INVERSION USING A NETWORK OF LIGHT RECEIVING SYSTEMS

C. Soares and S. M. Jesus

*Institute for Systems and Robotics, Universidade do Algarve,
Campus de Gambelas, 8005-139 Faro, Portugal.
Telephone: +351 289 800 949
e-mail: csoares@ualg.pt*

I. INTRODUCTION

The estimation of ocean parameters by means of the inversion of acoustic signals is a research topic that aroused significant interest during the 1990s, and in several occasions its viability has been demonstrated [1], [2], [3]. However, most of the experimental shallow-water studies aiming at the estimation of ocean parameters by means of the inversion of acoustic signals used only a single vertical array for data collection and a single acoustic emitter. This limits the spatial coverage to the environment between the acoustic emitter and the receiver system. As an attempt to increase the spatial coverage, the emitter may eventually be towed over the area of interest remaining, however, still limited to "look" into a single direction at each time, being therefore unable to simultaneously estimate environmental properties of multiple ocean transects. Multiple ocean transects can be simultaneously estimated if a network of receiving nodes is used as this allows for collecting acoustic waves traversing the ocean in different directions. Another aspect is related to operability issues: environmental inversion concepts such as ocean tomography may become significantly more interesting if performed as real-time application [4]. For example, if estimates on oceanographic properties such as water temperature could be obtained shortly after the reception of the acoustic signals, these could be fed into existing ocean

circulation models that nowadays can produce oceanographic forecasts up to 48 hours [5].

The RADAR'07 sea trial, held in the sea of Tria off the Portuguese coast approximately 50 km South of Lisbon, served the purpose of testing a network of receiving systems with two nodes, and perform real-time environmental inversion using that network receiving systems. This area has a very strong activity in terms of internal tides. Each node consist of an exemplar of the Acoustic Oceanographic Buoy (AOB) [6], which uses a surface buoy and an underwater array of acoustic sensors (AOB1 with 8, and AOB2 with 16) and non-acoustic sensors. Among several other characteristics the surface buoy includes a digital storage unit for the acquired data, a wireless communications system for remote monitoring and data transmission, and GPS system. These features allow for carrying out inversions as the data can be transferred from the buoy to a platform equipped with processing capabilities before recovery. These buoys are easily deployed and recovered for their small dimensions, and since they can record their geographic coordinates they can be deployed in a free-drifting configuration. In few words the AOBs' design represents a significant step towards operability in comparison to traditional acoustic receiving systems.

