The Acoustic Oceanographic Buoy

A Light Acoustic Data Acquisition System

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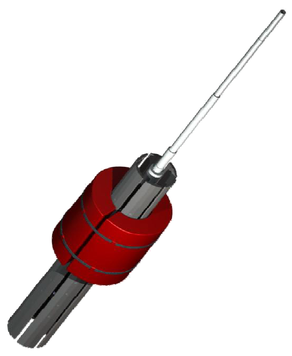
Introduction



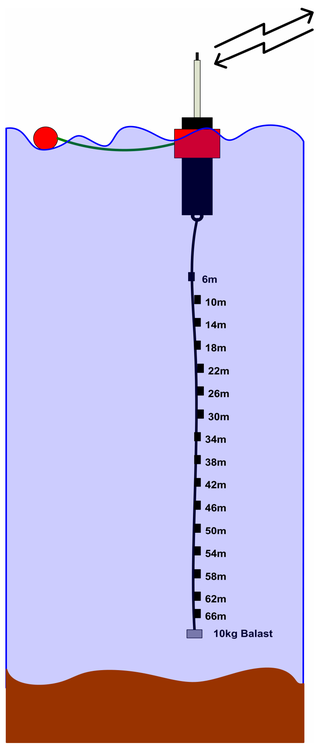
The Acoustic Oceanographic Buoy (AOB) is a light acoustic receiving device that incorporates acoustic and non-acoustic signals received in various channels along a vertical line array that provide oceanographic and environment measurements all of which are uniquely GPS time referenced. The physical characteristics of the AOB, in terms of size, weight and autonomy, will tend to those of a standard sonobuoy with, however, the capabilities: of local data storage, dedicated signal-processing, GPS self localizing, real-time monitoring and online data transmission.

Description

- Surface buoy with small dimensions (1.2m body plus 1.8m mast) and weight (45kg).
- A vertical line array (68m) has 16 hydrophones with 4m spacing and 16 thermistors for acoustic and non-acoustic data.

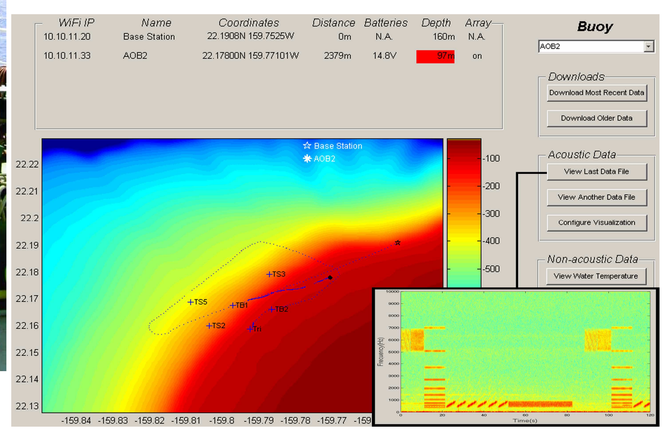
AOB Hardware and Software

- Standard x86 PC/104 CPU running Linux OS
- 120 GByte hard drive storage for *in situ* storage.
- Dedicated Processing board TMS320C6713 DSP.
- GPS Synchronization and Positioning
- standard WLAN for communication
- Li-on battery with 48Ah, permits 12 hour deployments.
- 16 channel, 50kHz sampling rate
- Real-time Remote Monitoring, Tracking and Control



AOB internals

Base Station Monitoring Program



Sea Trials

So far, the AOB was deployed in several sea trials such as:

MakaiEx'05 (Pacific) Hawaii

Objectives:

- High-frequency acoustic methods for environmental based underwater communications,
- HF tomography
- HF matched-field processing, time-reversal or PPC based communications.

During this sea trial the AOB was deployed multiple times with success both in free drifting and tied to ship configuration.

BluePlanet'07 (Mediterranean) Italy

Objectives:

- Geo-acoustic inversion
- Oceanographic tomography using ocean prediction models under the Rapid Environmental Assessment Concept.

RADAR07 (Atlantic) Portugal

Objectives:

- Online ocean acoustic tomography (using the AOBs WLAN network)
  - Low frequency using the network tomography concept (two AOBs were deployed)
  - High frequency for detecting features such as internal waves and sea currents.
- Underwater communications and time reversal testing.

UAB07 (Fjords) Norway

Objectives:

- Shallow water underwater communications in an open fjord.
- very shallow waters (30m) of a bay, for a real-time underwater acoustic barriers for detecting underwater intruders.

The network and processing functionality of the AOB was critical to the success of this experiment. The received signals were pre-processed and this reduced data set was transmitted via WLAN to the base station where it was time-reversed and acoustically re-transmitted.

Applications

Underwater Communications:

The AOB functionality allows for the implementation as a network interface between an underwater acoustic network and an air radio network. Processing capabilities allow for the implementation of a full demodulation system when used in non-coherent underwater acoustic data communications.

Passive Localization:

The localization in open waters with the AOB either in a fixed or free drifting configuration is of great importance in applications such as homeland security and mammal monitoring where the processing and communication facilities are suitable for the implementation of simple array processing passive localization algorithms.

Underwater Acoustic Barrier:

The creation of underwater acoustic barriers are of interest for harbor and straights underwater security and monitoring. The AOBs real-time reception, processing and network transmission enable implementing a time-reversal algorithm with objectives of continuously monitoring an underwater area of interest.

Acoustic Rapid Environmental Assessment:

For REA applications the AOBs size and weight allows for rapid deployments and due to its DSP facility, the AOB is suitable for performing distributed digital signal processing tasks. The processing capabilities of the the AOB allows for great data reduction and online transfer using the remote network communications for near real-time acoustic data inversion.

Conclusion and Acknowledgements

Throughout the past four years, the AOB has demonstrated to be handy, allowing for several deployments in each sea trial. The data collected at sea shows that the AOB is a versatile, robust and easy to use tool for a variety of broadband underwater acoustic applications, and having operated as a service to the international underwater research community in a relevant number of sea trials.

- A. Silva, F. Zabel, and C. Martins. Acoustic oceanographic buoy: a telemetry system that meets rapid environmental assessment requirements. Sea-Technology September 2006.

- The AOB system was developed under the NUACE (POSI/CPS/47824/2002) and RADAR (POCTI/CTA/47719/2002) projects supported by the FCT
- SipLAB - http://www.siplab.fct.ualg.pt/