pick the seismic phases. Alternatively, WAS processing is also done using existing tools chiefly designed for MCS geometries and not all the techniques are therefore well-suited for proper WAS processing. One of the objectives of Sigsensual has been to design a new adapted software tool allowing to perform all these operations using a single, easy to use, modular platform [2].

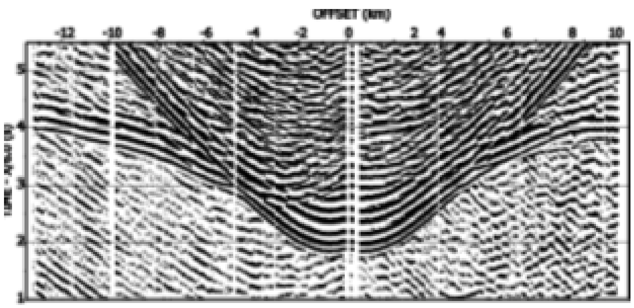

Figure 2: Record section (offset-travel time diagram) corresponding to the recording of airgun shots by an OBS.

In contrast to MCS, wide-aperture WAS acquisition systems are specifically designed to record both the reflections and the continuous refractions of the seismic waves propagating through the medium. This makes that the obtained record sections (Figure 2) do not yield directly interpretable images of the sub-seafloor, being necessary to built models accounting for the propagation velocity of the seismic waves in order to interpret the data.

Until very recently, seismic velocity models were obtained either by forward modelling or by travel time inversion, and therefore the basic data pre-processing consisted of allow identifying and picking the most prominent seismic phases recorded by the system (chiefly first arrivals). However, the fast increasing on computing facilities have allowed developing tomography techniques that use not only first arrivals but the full wavefield. It is therefore necessary to design more elaborate processing sequences to make WAS data amenable to this type methodology.

Useful seismic phases present in the record sections are usually masked by different types of noise, which may be caused by the instrument (electronic noise, quantification ...), by the environment (ship noise, cetacean, sea wave course, currents ...), or even by the signal itself (higher order reverberations and scattered signals which obscure later arriving prominent phases). Another of the objectives of Sigsensual project is to design filters and processing sequences allowing to obtain as much of the valuable information contained in the record sections as possible, by improving the signal to noise ratio, as well as removing or attenuating some well characterized phases, such as the water wave or its reverberations [3].

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Characterization of the water optical properties using hyperspectral

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1. Introduction

Hyperspectral instrumentation has opened a new door for optical oceanography and related fields that make use of optical remote and in situ sensing of the oceans. Hyperspectral information provides optical oceanographers the potential to accurately quantify and classify complex oceanic environments, finer-scale features (e.g. bottom type and characteristics and phytoplankton blooms), depth-dependent inherent optical properties (IOPs) and specific chemical compounds [1]. For instance, the hyperspectral instrumentation has made possible the remote identification of different taxonomic groups of phytoplankton due to that some pigments are unique to individual phytoplankton group or species [2].

The incorporation of hyperspectral sensors to autonomous sampling platforms of an oceanographic observing system makes essential to develop new spectral algorithms and techniques for the analysis of the hyperspectral data obtained [3] [4].

The SAMPLER project [5] coordinates the development of an oceanographic sonde in order to measure physical and biological parameters at small scale, and an integrated software package to analyse all the data obtained at small and larger scales. As it has been described, this integrated instrumental system will include a new hyperspectral sensor based on LIGA microsystems technology (figure 1). This sensor will be able to measure upwelling and downwelling irradiance spectra within the water column. Apparent and inherent optical properties (AOPs, IOPs) will be estimated from these spectral values.

2. Hyperspectral Analysis

The development of new spectral techniques for processing the high-resolution data obtained from the LIGA spectrometer can aid in the characterization of marine ecosystems.

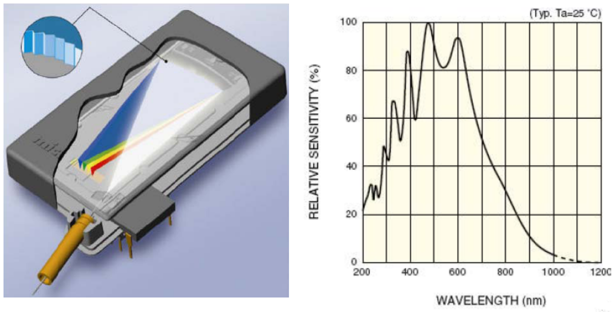

Figure 1. LIGA spectrometer and its spectral response.

The spectral techniques will be developed in two phases:

First phase
This will be a theoretical phase and will involve working with spectral data obtained by simulation. An initial set of spectral signatures with known features will be used to evaluate how efficient the spectral techniques are. Different in-water light fields will be simulated using radiative transfer numerical models [6]. The sensor response (spectral sensitivity, spectral resolution and signal-to-noise ratio) will be also simulated.

The spectral techniques for the analysis of hyperspectral data will be:

Derivative analysis
Derivative analysis is a powerful tool used in the analysis of hyperspectral data. It has been demonstrated how this method enhances small fluctuations in reflectance spectra and separate closely related absorption features [7]. These absorption features can be used to extract detailed qualitative and quantitative information about the environment evaluated.

Spectral deconvolution and unmixing
In hyperspectral data processing the unmixing of reflectance or fluorescence data can aid in the classification process based upon these spectra. In addition, extraction of useful information may be possible by reflectance deconvolution [8].

Wavelet Transform
It has been demonstrated that the wavelet-based method is practical for derivative analysis of hyperspectral signatures, specifically for computing scale-space images and spectral fingerprints [9].

Similarity index analysis
The similarity index has been used to correlate measured absorption with known phytoplankton absorption curves for identification purposes [10].

Second phase
This phase will be carried out once the oceanographic sonde will be entirely developed and measures from the water column taken with the hyperspectral sensor will be available. The spectral techniques developed during the first phase will be tested with experimental data.

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