GEOPHONE CALIBRATION PROCEDURE FOR OCEAN BOTTOM SEISMOMETERS (OBS)

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Abstract- This is a new calibration procedure for geophones using the expanded uncertainly [1] [2] of null-correction created in our laboratories.

Introduction
The geophone under study is the sensor used in an ocean bottom seismometer (OBS), with three orthogonal velocity transducers. It has been designed to work on the seabed, and has an external structure (Figures 1 and 2) designed especially to resist a pressure of up to 6000 m of water and to have good coupling to the sea bottom.

Figures 1-2. Geophone structure.

In oceanographic instrumentation and seismic prospecting, this equipment acquires the vibrations of the seabed, which can be either artificially generated (for example, compressed air-guns on board of an oceanographic vessels), or be natural seismic activity.

Development
Sensor calibration methods
The velocity sensor is a GS-11D at 4000 Ohms (with natural frequency of 4.5 Hz and 85.8 V/m/s of sensibility). The specification of the sensor is according to Geospace manufacturer.
Although we know the characteristics of the sensor working alone, this sensor is inside a structure which consequently modifies its seismic mass, and the coupling can modify the global specifications [3] [4]. For this reason we have developed a systematic calibration procedure for the geophones which can help to overcome this problem.
The calibration methods consist of repeating some frequency and amplitude sweeps, for every axis, to determine the following factors:
- Contribution to repeatability [2].
- Systematic error.

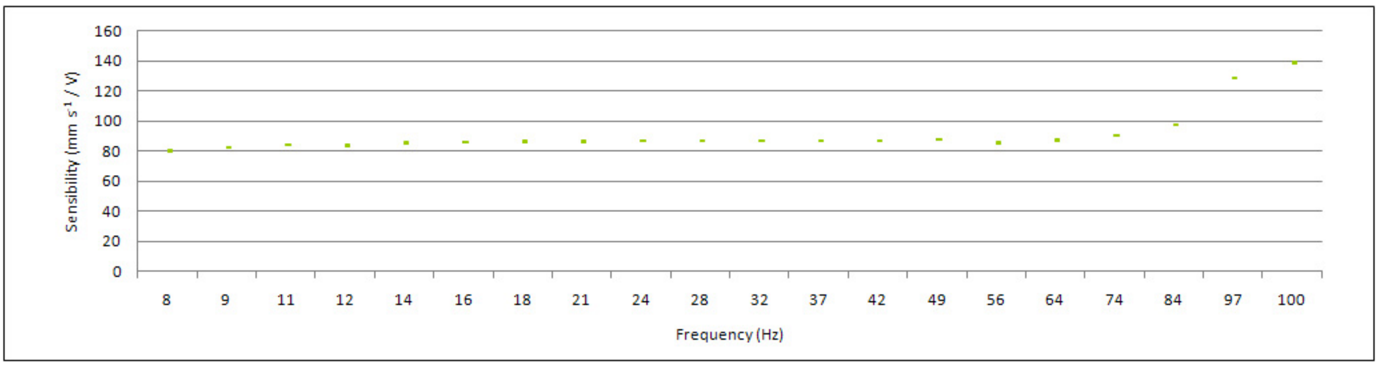
With this method we determine a constant value with an associated uncertainty [1][2].

Calibration Results
The results obtained after 4 repetitions of frequency sweeps, between 8 to 100 Hz in a range of 5 amplitudes, allow the determination of a sensibility in every axis X-Y of the geophone.
Figure 3 shows the results of the stability of the sensibility along the frequency when the frequency sweep operates in the X axis. In the other hand, Figure 4 shows the sensibility of the transversal axis when the movement is produced in the X axis.
Seeing the great variability of the sensibility from 64 Hz, we detailed the sensibility account of the axis between 12 to 64 Hz like a single value, with an extended uncertainty of the null global correction.
The sensibility of the device under test in the X axis is (85,78 ± 2,52 V/m•s-1)
Explanation: The study is centered on the interval between 12 to 64 Hz; this range has been selected because it covers the ranges of the input signals acquired by the geophone in a seismic earth prospecting.

Conclusion
We have developed a new procedure to calibrate geophones. With this method is possible to obtain the sensibility of each measured axis, and its extended uncertainty of the null global correction. In fact, the magnitude and direction of the velocity in the X-Y axis have been obtained.

References
[1] EA 4/02 Expression of the Uncertainty of Measurement in Calibration, 1999, European co-operation for Accreditation
[2] International Vocabulary of Basic and General Terms in Metrology, second edition, 1993, International Organization for Standardization (Geneva, Switzerland).
[3] X.Roset, M.Nogueras, A.Garcia, J.del Rio and S.Sarria "Geophone Calibration by means of hyperbaric chamber" OCEANS 09 May 11-14, 2009, Bremen, Germany
[4] X.Roset, A.Manuel and S.Shariat-Panahi "Contributions to calibrations of geophones beyond standard available" IMEKO 08, September 3-5, 2008, Annecy France.

(below) Figure 3. Geophone X axis sensibility.



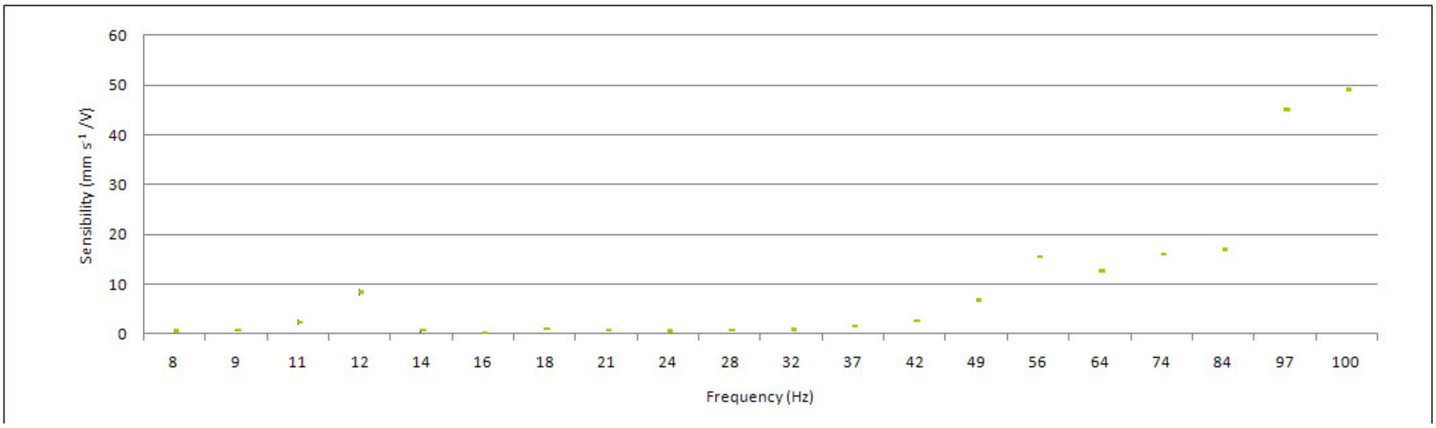


Figure 4. Sensibility of a Y axis when the vibration is in X axis.

DYNAMIC PACKAGING CHARACTERIZATION AUTOMATIC TEST SYSTEM

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Abstract- The optimization phase in the packet design process is important to ensure the integrity of the element to transport. For this reason, to know the frequency response of the packet in function of vibrations and other parameters an automatic test system has been design. In this article is shown test system and mainly the data acquisition system in order to acquire long temporal series of the vibration signals. The system is composed by a SCXI rack to provide accelerometer signal conditioning, USB data acquisition system and the real-time data processing is carried out by a personal computer and a LabVIEW application.

Introduction:
To ensure the packaging function in front of vibrations or shocks in freight transport is necessary to characterize the response of the packaging. It is considered the packagint as an element mechanically deformable and if we put a mass on top it can be modelled as a spring with a elastic constant Ks, and absorption coefficient , and theses parameters are being affected over the time.
In order to study the frequency response variation over time of the packaging and to know the evolution of its parameters Dr M. Garcia Romeu has designed a method in his PhD thesis for simulation of the real conditions that affect the packaging and be able to predict its behavior.
To know the temporal evolution of mechanical resistance of the packaging in front of the mechanical stress produced during transportation is the main objective of the design presented in this article.

System Description:
The design consist of a fatigue structure shown in figure 1, that provide to the device under test (packaging DUT) a gravitational

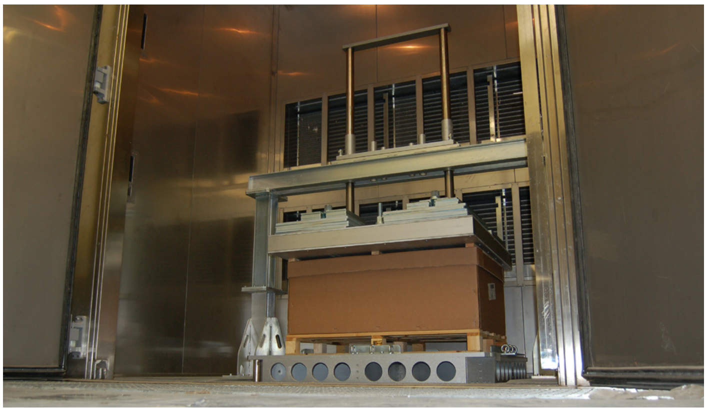

FIGURE 1. Fatigue Structure

load and a controlled vibration that is the mechanical stimulus. The frequency response to the stimulus (vibrations) are function of the dynamic parameters of the packaging Ks and . The signal processing of the stimulus and the packaging response, and the data acquisition of these two acceleration sensors has been carried out by a USB data acquisition system, a SCXI signal conditioning and a LabVIEW application, shown in figure 2.
The application developed provide configuration of the data acquisition and conditioning parameters, data archiving in files and data processing in order to visualize the frequency response of the packaging using the FRF (frequency respond function), extracting the characteristics parameters and his evolution over the time in a long duration test. This evolution defines if the