Low-frequency standards for hydroacoustics in the Infra-AUV project

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1) Introduction

- Low frequency Acoustics, Underwater Acoustics and Vibration (AUV) phenomena are used to detect major natural events such as earthquakes, tsunamis and volcanic activity.
- Also used by the International Monitoring System (IMS) of the Comprehensive Nuclear-Test-Ban Treaty Organisation (CTBTO) to check provisional treaty compliance.
- Low frequency sound and vibration monitoring technologies are well established; however the lowest frequencies of interest are not sufficiently well covered by current measurement standards which limits data reliability.
- Monitoring stations are also often located in extreme environments posing additional challenges for assuring the accuracy of measurements.
- This poster describes the work that NPL, TUBITAK and ASN are doing in the Infra-AUV project to develop calibration methods for hydroacoustics in the frequency range from 0.5 Hz to 100 Hz.

2) Objectives for Primary Calibration Development

- TUBITAK & NPL are working jointly on establishing the coupler reciprocity method for hydrophones in the frequency range from 1 Hz to 100 Hz.
- NPL is developing & evaluate calibration using a laser pistonphone from 0.5 Hz to 100 Hz.
- Interlaboratory comparison of hydrophone(s) calibrated using the laser pistonphone & coupler reciprocity methods.

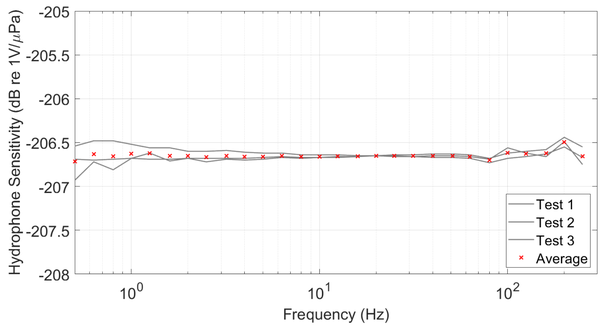
3) Additional metrology challenges

- For ocean acoustics applications, it is important to provide calibration methods that can be realised under ocean conditions of temperature and water depth.
- Dissemination of measurement traceability to the hydrophone models used at the in-situ measuring stations at ocean conditions is required.
- In-situ checks of calibration stability of hydrophones in measuring stations is a major challenge – more difficult than for land-based stations.

4) Laser Pistonphone – Unique to NPL

- Small coupler driven by piston.
- Piston motion determined using optical interferometer.
- Air-filled - pressure depends on compliance and volume change.
- Suitable for very low frequencies (<0.5 Hz).

5) Laser Pistonphone – Results

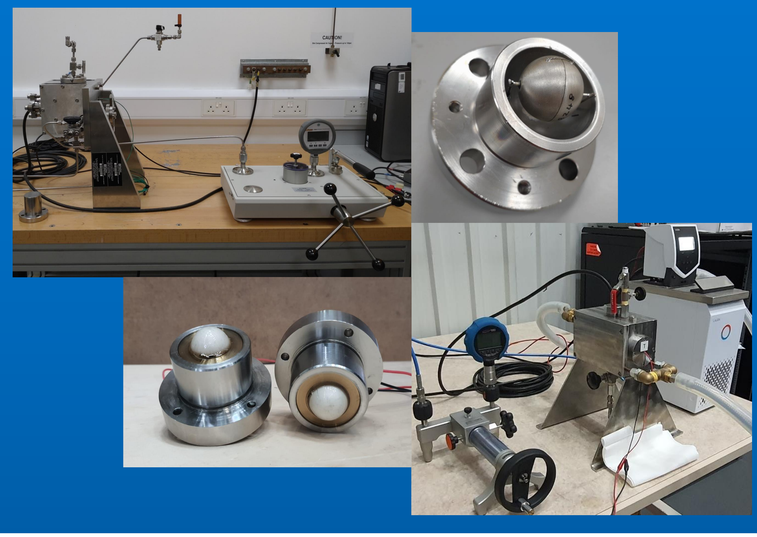


6) Laser Pistonphone – Future Work

- Repetition of measurements over a period of time to ensure stability.
- Validation by calibrating other transducers with known responses, e.g. a SETRA barometer, known to have a flat dynamic response from DC to several hertz, and a microphone calibrated at LNE.
- Reduce the frequency down further to see what the measurement limit is!

7) Coupler Reciprocity Method – NPL & TUBITAK

- Three transducers inserted into small coupler.
- Acoustic sensitivities calculated from purely electrical measurements.
- Water-filled – may be used to simulate ocean conditions (temperature, depth).
- Suitable for 1 Hz to 1 kHz.



8) Coupler Reciprocity – Preliminary results

- NPL – Results obtained for a B&K 8104 have a high degree of variability.
- TUBITAK – Validation measurements between transducers have been undertaken (projector to hydrophone) with good results down to 1 Hz.

9) Coupler Reciprocity – Future Work

- NPL – Understand the sources of variability in the measurement process and reduce the impact these have on the calibration in order to gain stable results.
- TUBITAK – Calibrations will be conducted in the frequency range from 1 Hz to 100 Hz at different ocean conditions by varying the temperature and the pressure of the coupler chamber.

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