PROJECTOR MEASUREMENT TECHNIQUES AT LOW FREQUENCIES

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1. INTRODUCTION

Active SONAR system can use low frequency projectors (typically below 2 kHz). The designer of such system makes prototypes which are tested in pressurized tank in order to analyse the behaviour of the transducer according to hydrostatic pressure and the temperature. Due to the size of the tank the pulsed sound technique which is currently used in acoustic laboratory cannot be efficient at frequencies below a given limit (depending on the size of tank) which is about 2 kHz [1]. Hence the prototypes of this type of transducer cannot be measured in tank. A few laboratories make a lot of efforts in order to develop techniques adapted to the measurements of such transducer in tank. In the laboratory of DCN Ingenierie different studies have been undertaken. In this paper the results of some of then are discussed.

2. CORRELATION TECHNIQUE

On the cross correlation function between the input signal of the projector and the output signal of the receiving hydrophone it is possible to remove the effect of the boundary echoes of the tank if the peaks of this function are narrow enough by applying a window.
This technique is efficient to measure hydrophones below 2 Khz but this technique is not adequate for the measurement of transducer whose radiated impedance depends on the confining conditions [2]. The figure 1 corroborates these remarks. As a matter of fact in this figure we compare the measurements obtained on a double-ended longitudinal vibrator using this technique to the results obtained in lake using pulsed sound technique (reference curve).
It can be noticed that the 650 Hz resonance is not seen by the correlation technique. This resonance is due to a cavity of the transducer. This resonance does not occur in confined environment.

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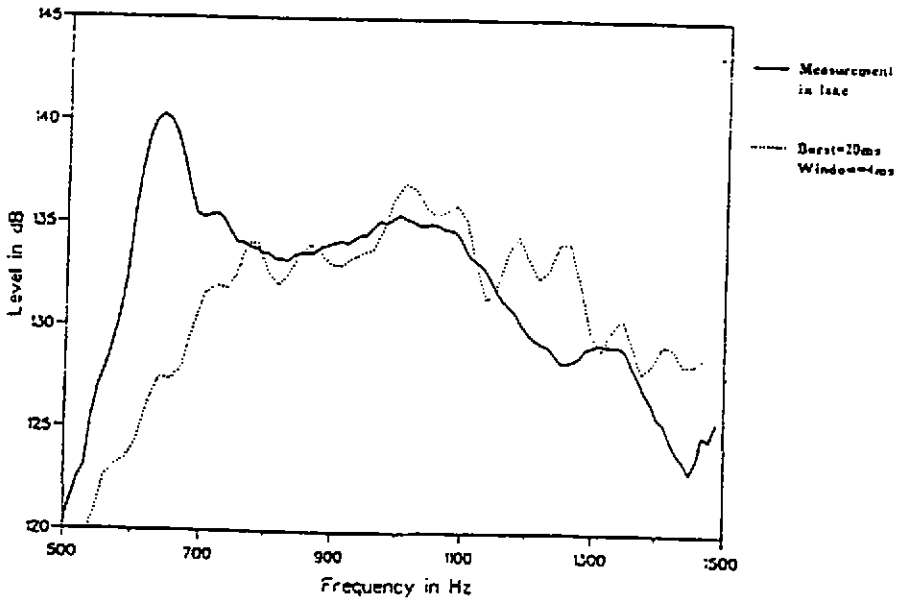

Figure 1 - Measurements on a double-ended longitudinal vibrator

The same phenomenon exists for a free flooded transducer. The 700 Hz resonance is not seen when the correlation technique is applied (see figure 2).
For this type of transducer the methods which remove the effect of the echoes only on the receiving signal are not efficient because the echoes due to the tank modify the response of the transducers.

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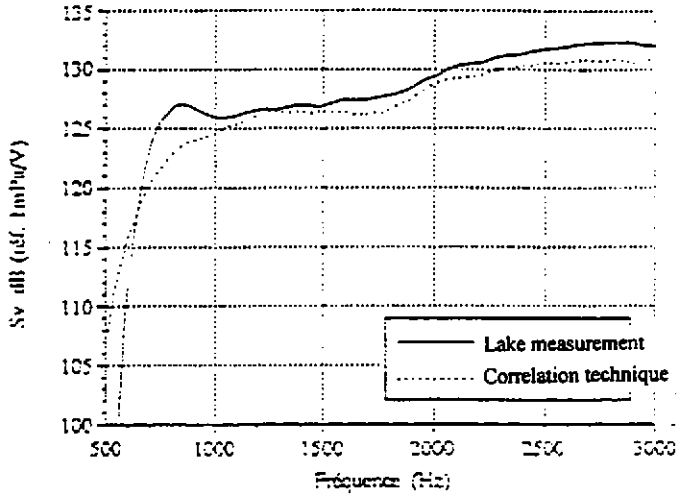

Figure 2 - Measurements on a free flooded transducer

3. SUPPRESSED TRANSIENT TURN ON AND TURN OFF METHOD

The most promising technique consists in applying a specific input which reduces the transient part of the signal. This technique allows the measurements before the arrivals of the echoes due to the tank. During a collaborative research with the United States naval research laboratories we have tested a method based on this idea [3]. The driving voltage wave form consists in a sum of a pedestral voltage plus a ramp voltage plus a sinusoidal voltage. The parameters of this driving voltage are calculated knowing the equivalent circuit of the transducer of interest.
This method is very efficient but does not permit high voltage measurement due to the limitations of power amplifiers because of the superposition of the different excitation signals.
To solve this problem, we have developed a specific method in our laboratory which reduces the transient signal regardless of the application of the high input driving voltage (a pattern has been registered).

4. CONCLUSIONS

We have presented the main results obtained during our studies on measurement technique for low frequencies transducers. We have shown that the response of such transducer depends on the confining conditions. Hence, the methods which only reduce the effects of the echoes due to the tank on the receiving signal are not adequate. The most promising methods must reduce the transient part of the transducer response signal.

5. REFERENCE

[1] C. GIANGRECO : Mesures acoustiques appliquées aux antennes sonar. Edition TEC & DOC - Lavoisier (1997) n° ISBN : 2-7430-0225-5. (Chapitre 1).

[2] C. GIANGRECO : Mesures acoustiques appliquées aux antennes sonar. Edition TEC & DOC - Lavoisier (1997) n° ISBN : 2-7430-0225-5. (Chapitre 4 et 5).

[3] J.C. PIQUETTE Method for transducer transient suppression. J. Acoust. Am (1992) - Sept. p 1203-1221