

USE OF A TRUNCATED CONICAL TANK TO IMPROVE UNDERWATER ACOUSTIC EXPERIMENTS

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Abstract – Experimentation in Underwater Acoustics field presents several difficulties derived from the environment selected (sea, ocean or lake) and its accessibility. A priori, these drawbacks can be solved in closed test environments such as cylindrical and parallelepipedical shaped tanks typically used by scientific community. However, in these scenarios, diverse physical phenomena provoke the signal perturbation. In this paper, these crucial problems are analyzed and it is presented the advantages of using a truncated conical tank in Underwater Acoustics research.

Keywords – underwater acoustics, reflection, multipath, tests tank, truncated conical tank

INTRODUCTION

Underwater Acoustics is a scientific field which deals with the study of underwater sound propagation of physical signals, involving the generation, transmission and reception of acoustics waves. In particular, Underwater Acoustics analyzes how the medium variability has an influence on signal communications. For instance, the depth, temperature or salinity leads to changes at the sound velocity of the waves transmitted. Furthermore, several physical phenomena such as reflections, scattering, reverberation, absorption or Doppler effect can affect significantly to the signal propagation. It can be also disturbed by different sources of noise. All those phenomena result in a decrease of the wave strength, and many occasions, the signal loss. Therefore, it is an important issue to consider, which is studied in this paper.

TRADITIONAL UNDERWATER ACOUSTICS EXPERIMENTATION

In order to test underwater devices and take acoustics measurements, an appropriate test scenario is required. A first option is to deploy an acoustic source and a receiver in the sea. However, research in this environment or in other real scenarios such as oceans or lakes may result highly difficult and expensive. Sea tests require renting specialized infrastructures like a ship, and so, there is a need of planning the experiment with enough beforehand. Furthermore, the weather is another important requirement to take into account in an outdoor deployment. Bad atmospheric conditions would involve high costs and delays.

This leads us to notice the advantages of using an accessible and controlled tests environment [1][2]. A tank solves these aforementioned shortcomings, providing an efficient test-bed environment for signal probes. However, the usage of a simple hydroacoustic tank with a parallelepipedic or cylindrical shape involves new drawbacks. In particular, in these closed environments, the most significant physical phenomenon is the signal reflection which has adverse influence on transmission, being even more relevant than the produced one into a sea environment. Usually, in the sea, the reflection appears when the waves bounce in the surface or the bottom. In a tank, the increase of signal reflections

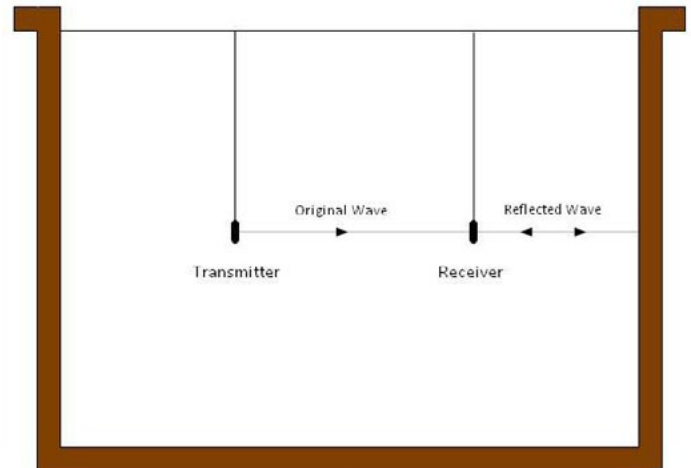


Fig. 1. Typical controlled environment.

is considerable due to additional bounces in the walls of the tank (Fig 1). Therefore, when a source device transmits a signal, the waves generated will arrive to the sink with different phases (this phenomenon is denoted as multipath). In this case, if the delay between the direct wave and reflected ones is short, the sink receives a mix signal formed by direct and reflected waves, not being able to distinguish them. These interferences and fading phenomena provoke that the sink does not comprehend the information received. To avoid these drawbacks, we should work with a special shaped tank, where the experiment can be controlled and also the process is quite similar to the one in the sea, decreasing the number and strength of the waves reflected.

HOW TO SOLVE THE AFOREMENTIONED PROBLEMS: TRUNCATED CONICAL TANK

The way to work in a controlled environment and avoid extra reflections derived from the presence of physical boundaries is solved by using a tests tank with a special geometry. The best solution known so far is a truncated conical tank (Fig.2). The leaning walls deflect reflected waves upward avoiding them to get the sink.

In this sense, the tank at Technological Naval Center in Murcia, Spain is the only tank in the entire country with this advantageous shape. With 10 meters depth and 20 meters diameter, its truncated conical shape comprises the best scenario for developing underwater acoustic tests. The layout with the transducers in the tank can be seen in Fig.2.

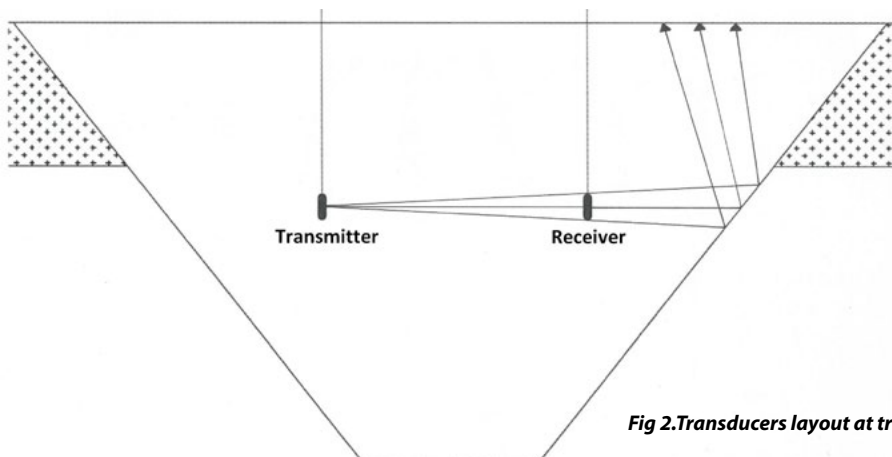


Fig 2. Transducers layout at truncated conical tank.

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