

APPLICATION OF SOUND PROPAGATION (IN THE PERSIAN GULF AND OMAN SEA)

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Abstract

As it is a real concept in nature, more than 70% of the earth surface is covered by water such as Seas and oceans. Surface water on the earth is linked together. Knowing phenomena and organisms underwater has been a purpose in human life; why this aim is used in some industries and sciences. Sound is known as a mechanical wave with many applications in seawater. Obstacle, organisms, objects and even each purpose like a driver, a mass of particular fish or sediment types on the bottom could be recognized and be studied when their physics and properties would be known. Acoustics as an applied science as a regards of much research importance using mechanical waves moving underwater is a helpful tool to reach this useful scientific aim. In this paper following a one year study and research after explaining application of some marine acoustical instruments, horizontal and vertical sound propagation created by some particular instruments will be analyzed.

Keywords: Sound, Wave, Frequency

1. Introduction

Many places in sea water or oceans because of much depth or not availability are away from human reach (Heathershaw, 2001). For example sedimentation rate, water animal passing or topography changes are not easy to be studied because people could not know about there and phenomena happening. By using some special instruments called acoustical ones and by sound waves, propagating horizontal and vertical rays help to obtain photos, profiles and simulations of the subjects taking place in particular locations underwater (Hirohito et al, 2002). In fact sound waves after striking bottom, obstacles or any aim item such as a mass of wanted fish or a diver swimming in a particular long/ lat and depth of a water basin are reflected having a special frequency and physical properties depending on the purpose thing surface and then are received by receiver part of the acoustical instrument got on a research ship. Finally, tables of data, diagrams, curves, photos and some simulations are obtained from the purpose item. So each matter as the purpose thing absorb a special rate of received frequency of sound waves and therefore, each obstacle in route of sound waves underwater has some depending physical properties for sound waves reached to. Of course, it is required to employ some experts and also professional software to analyze received reflected sound rays from each obstacle or thing underwater being studied and wanted to consider. It is important to notice that for each direction of propagating the sound rays as mechanical waves and for each special domain of distance the waves moving under some particular physical properties of seawater, sending sound waves should be done with given frequencies to obtain clear photos, simulation the purpose to be studied and for knowing about would be on the bottom of water basin such as sediment particles and enemy mines or kilometers or more through horizontal direction parallel to sea surface and bottom (Park and Kaneko, 2001). Thus we need to use some special acoustical instruments to propagate sound waves with particular studying appointed frequencies to result in applied useful conclusions showing good information about the purpose of research. Sound propagation and processing reflected waves from a purpose would result in getting applied information leading to details about it; even we could mention its application in oil industry, meteorology and mapping. Therefore our duty and responsibility is studying in this field and extend its application in all possible industrial and scientific expertise. In fact, based on application and direction of sound waves propagation underwater, the instrument is selected and experts send some special sound waves (in recognized appointed frequency domain) and then processing reflected waves, the optimum results including simulations or data requires will be studied.

2. Different marine applications of sound waves

Sound waves have overall different uses in industries and sciences. Such as: marine applications, meteorological uses and in petroleum and gas industries (Harrison, 1998). Almost all of sound waves propagation applications in different sciences and industries include detecting and illustrating a particular obstacle or aim (Jaffe, 1997). In fact in marine uses of sound waves propagation, we need to obtain a clear simulation or picture of a purpose underwater. So, application of sound waves propagation extend in all environments such as air, water, earth or each solid. Of course there are different instruments for industrial or researching uses that in each case, frequencies and energies of required waves sending to purposes or for some purpose are different from others to be appointed and should be used.

3. Marine applications of sound waves

There are some highlight uses of sound propagation underwater useful for different jobs and industries related to sea research (Clay, 1977). Also sound propagation in sea water has another application in topography and taking photos of basin bottom. By this, topography of the basin bottom would be appointed and studied; changes in depths of water basin are appointed and it will be studied because of an important application, therefore sedimentation and bottom destruction could be rated accurately. Sound channels could be formed in all deep water and Ocean. It could be observed that sound channels are not formed in some shallow water basins. In other shallow waters such as the Persian Gulf the sound channels usually form weakly. In fisheries, it is usually important to know which kind offish mass and how to enter a water basin. For example which kind and with which

accumulation of a particular type of fish and when are entered to of a particular type of fish and when are entered to water of the Persian Gulf. Or the need to know about some special plants growing on the Persian Gulf bottom. In marine petroleum it is important to investigate positions of oil and its depth in a sea or ocean. By this, experts and some related professional study different positions of the bottom to understand which depth petroleum could be obtained. In shipping, by using some special acoustical instruments, we could propagate sound waves vertically in sea water from surface to bottom and illustrate topography the bottom. By this, depth changes are got as and extended photo of the bottom on special papers. Also by using acoustic instruments, we could measure physical and chemical properties of sea water such as temperature, salinity, conductivity and impurity type in sea water. Another applied purpose of using sound waves propagation underwater is measuring velocities of water currents in different locations of a water basin such as a delta, strait or mouth of a river linked to a sea or ocean; why this phenomenon has some good scientific and researching effects in water regimes there.

4. Mechanism of an acoustical instrument

There are some different acoustical instruments to simulate any particular purpose or aim thing in direction of horizontal or vertical. Some of these instruments as helpful tools are as the following: Each instrument is linked to a receiver, usually installed in drift and a computer equipped by necessary soft waves (James and Yves, 1994). Simulating or taking a clear photo from purpose underwater needs to send some acoustical waves by the instrument towards it; of course this task is done when we recognize and appoint correct frequencies required to receive better and more clear picture showing more and accurate details (Xun and Zhang, 1999). In fact sound waves are transferred through the medium sent in velocities range different in solids, liquids and gases. Its velocities in sea water range about 4.5 to 5 times of the velocity in air, that is, 1400(m/s) – 1600(m/s) and it has more values in solids. It should be said that these waves like others have orbital movement along a direct route appointed when shot from the instrument. A good simulation and taking a clear and optimum photo from an obstacle would be got when the waves are sent with an accurate frequency, why each purpose in a distance from the instrument needs a correct frequency for reached wave to reflect good and correct information including details about material and characteristics to be simulated.

5. CTD, Echo sounder, sonar and velocity meter

5.1 CTD (or STD)

An applied tool to measure properties of water sample in sea in a given long/ lat / depth position and to obtain physical and chemical information is called CTD. Of course it is usually called STD, that is, Salinity - Temperature Depth in place of Conductivity- Temperature -Depth due to water conductivity functionality to salinity, $C=C(S)$. By this instrument, user sends sound waves as physical rays to a particular long/ lat/ depth position of water under given frequencies and then analyze received reflected waves from water molecules and salt particles in the position by using special software, computer of the instrument equipped by. Sending optimized waves with good and applied frequencies to given positions; information obtained analyzing received waves will be well useful to be used.



Example Figure 1: A typical CTD (Mosaddad, 2004)

5.2 Sonar

A very important acoustical instrument, particularly in marine military and fisheries industries is called sonar. It has different types of various sizes and quality of information obtained using applied. The main part of this instrument is sent to a depth of water under the research or military ship fastened by a winch or cable to link it to the receiver of the instrument and ability to telecommunicate information to the computer equipped by necessary soft waves in control room of the ship. As it is shown in the following figure, directionality of sonar appoints direction of the wave's propagation underwater; so purposes in that direction will be illustrated and simulated for next studies. This instrument could usually send sound wave to several kilometers to detect aims.



Figure 2: A schematic of sonar (Apel, 1990)

In fact Sonar is an instrument in marine uses helps us to send acoustical waves horizontally to simulate things, purposes and obstacles like submarines or a floating person underwater. Of course this result will be got processing reflected waves from sent ones to them by some equipment or software installed computer system on ship in control room.

5.3 Echo sounder

Echo sounder is an acoustical device to take photos from bottom; by this, it is possible to study depth changes in a given location or a domain of a water basin bottom. It is an acoustical instrument that uses sound waves propagation vertically. Some sound waves with given frequencies (through a wanted frequency interval) depending of water properties there are sent along surface-bottom direction and processing received reflected of the bottom analyzed by computer part of the instrument equipped by some particular soft waves. In fact by using this acoustical instrument, sounding a basin in given and wanted places in a water basin through its bottom would be done and by this, topography of the basin bottom will be appointed.



Example Figure 3: A typical echo sounder to drown topography (Arnoldo, 1999)

We can say that CTD is an instrument in marine uses helps us to send acoustical waves vertically to simulate things, purposes and obstacles on bottom like mines. Of course this result will be got processing reflected waves from sent ones to them by some equipment or software installed computer system on ship in control room.

6. Conclusion and discussion

By using acoustical instruments, horizontal and vertical photography underwater is done from each obstacle or particular purpose like a diver, a mine, a fish mass or bottom of a water basin (Xun and Zhang, 1999). That is, sound waves sent from the instrument could move kilometer through horizontal and vertical direction in water to reach wanted purposes. Of course, an important point in this view is correct frequency interval for sending waves to propagate underwater reaching the purpose and resulting true simulation of it accurately. In fact, acoustics or physics experts using some special acoustical instrument on the wanted results and particular waves in correct direction underwater, will get optimum and applies details or data about the purpose they are looking for.

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