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Proceedings of Symposium on Ultrasonic Electronics, Vol. 31 (2010) pp. 407-408
6-8 December, 2010

Measurement of Ship Noise in Shallow Water

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1. Introduction

While analyzing ship-radiated noise data that were taken in shallow water off Korea, we observed interference structure of acoustic frequency and for ranges. Acoustic propagation in shallow water is strongly affected by interaction with the bounhdaries of the ocean surface and sea floor.[1),2)] This multipath propagation leads to interference structure in the received signal, both spatially and temporally.[3),4)] The nature of this interference structure is strongly dependent on the geoacoustic parameters of the sea floor[5)]. In this paper, the interference cycles are calculated on the two different sediment types such as rock(station1) and sand(station2) bottom. Analysis method in this paper uses the pressure level as a function of range and frequency at a varyous receiver depth.

2. Measurement Conditions

On August 17, 2009, the Ocean Acoustic Laboratory–KORDI conducted an acoustic experiment off the east coast of the Jukbyeon harbor. The purpose of this experiment was to perform sediment characterizing using broadband sound source in shallow water. The experiment site was bounded by 37 04N to 37 09N and 129 22E to 129 26E. This area was chosen because of its relatively flat bottom and good bottom reflection properties. The bottom depth of the both station were 25m. Vertical line array and one fishing ship as a sound source are employed in this experiment. For data acquiring, the vertical line array which is composed of 10 hydrophones served as receiver. The specification of the ship is described in **Table I**.

Table I. Specifications of the source ship

Name	IlJin
Use	Fishing Ship
Stuff	FRP
Gross ton	10
Miscellaneous	6 cylinder single diesel engine Generator 7kW Three blades Reduction rate 2:1

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Source–receiver positions were determined from the global positioning system (GPS) coordinates measured. The hydrophones are equally spaced at a distance of 2m in array. The acoustic data were collected on course runs at a ship speed of nominally 10 knots. The geometry of the experiment is shown in **Fig. 1.** The source ship closes along a heading parallel to the axis of 25m depth line from a range of 1200m to a close point of approach (CPA) of 20m. Sound speed profiles calculated from CTD alone during the acoustic transmission. From **Fig. 2**, it is clear that there is not considerable variability in the measured sound-speed profiles. Averaged SVP decreased by about 1495m/s toward the bottom. Winds were calm and the sea state was nearly zero. The bottoms are described in a geologic survey of the area as consisting of a rock and sand overlying limestone.

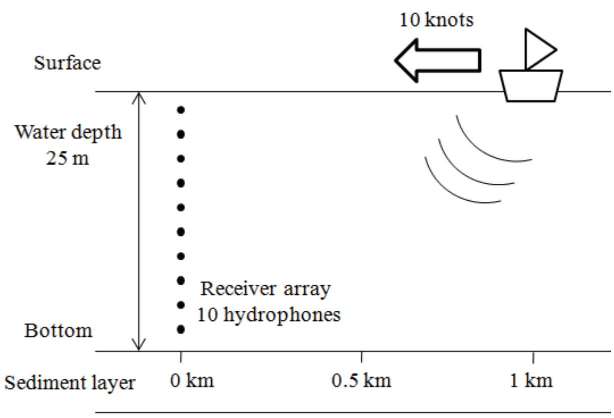

Fig 1. The geometry of the experiment.

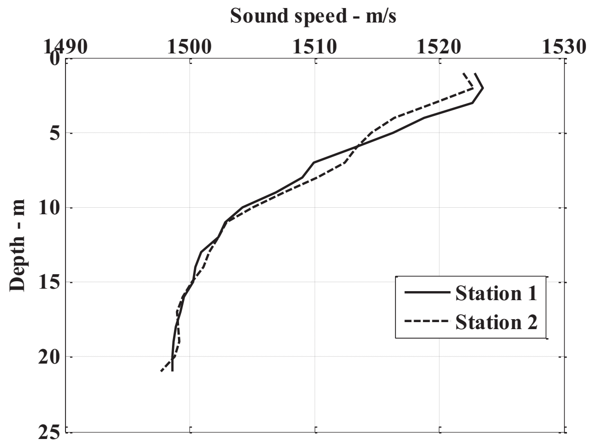

Fig 2. Sound speed profiles calculated from CTD

3. Results and Discussion

Fig.3 and 4 show the Interference structure of the received signal in frequency domain for both rock and sand bottom. The Interference cycle on the rock bottom was 219 Hz shorter than sand bottom at 23m receiver depth. And the difference of the interference cycle at 24m receiver depth was 148 Hz. As the receiver depth goes up, more peaks of interference appeared and the cycle was shorter to around 70Hz. The pressure level of the rock bottom is generally higher than sand bottom. This is because sound pressure is more attenuated in sand bottom than rock bottom. Quantitative analysis of the interference cycle between rock and sand sediment is necessary on the future work.

Acknowledgment

This work was supported by the project “A study on variability in coastal environment of the East Sea” (PE98444) at Korea Ocean Research and Development of Institute (KORDI).

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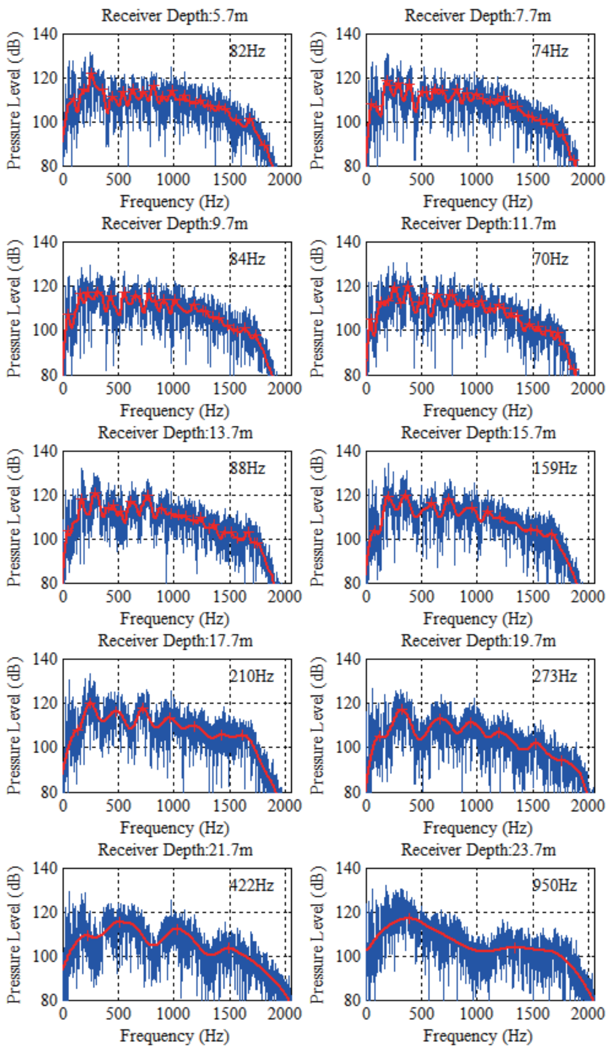

Fig 3. Interference structure of the received signal in frequency domain (rock bottom)

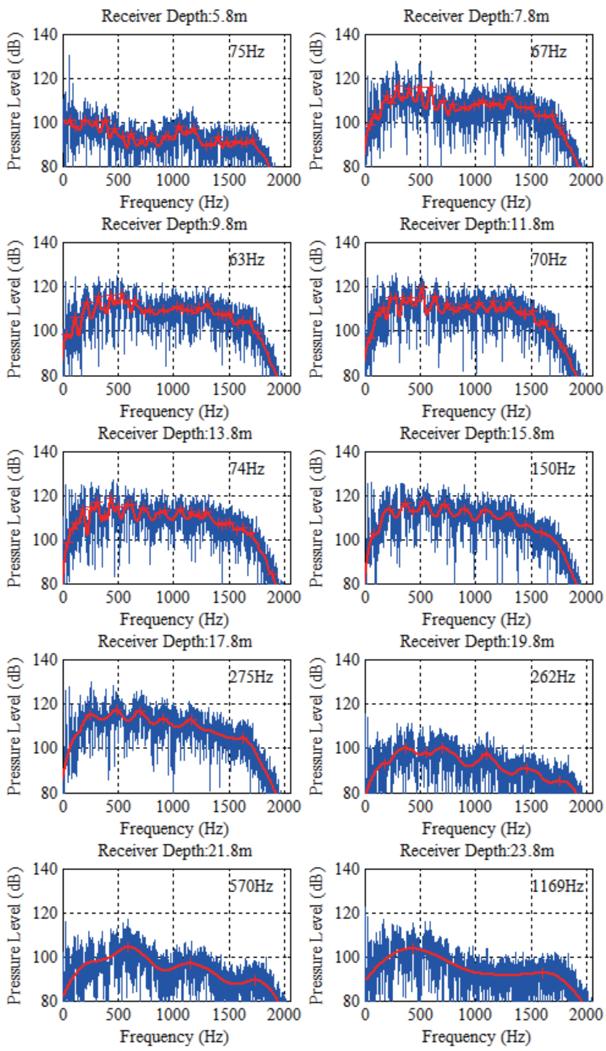

Fig 4. Interference structure of the received signal in frequency domain (sand bottom)