A study on The Simulator for Abstracting Underwater Acoustic Communication Channel Characteristics for Reporting of Wastewater Pollution Degree

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Abstract. In this paper, we are investigated to send sensing data of wastewater's pollution degree to simulator for abstracting underwater acoustic communication channel. It transmitted signal from sensor undergo attenuation according to propagation distance and is reflected on the bottom or surface of water. In this paper, we were shown to result the simulator that this channel characteristics was abstracted using the simulator.

Keywords: Underwater, Acoustic, Channel, Simulator, Tool, Sensor

1   Introduction

Recently, people pay attention to water resource and they want to manage it systematically. Corresponding with this situation, it has been investigated to measure the pollution degree of wastewater automatically[1-3]. In general sensor should be located in underwater and gathered data should be transmitted via underwater circumstance. Although there are able to be lots of communication medium like microwave, light or acoustics, we decided to use acoustic communication. When sending sensing data from sensor to server in underwater, acoustic signal undergo attenuation according to propagation distance and is reflected on the bottom or surface of water. So received signal has similar pattern of multiple attenuated signal with propagation delay. In order to communicate with high stability, communication channel should be analyzed in detail. But it is impossible to calculate it manually. To overcome this limitation, we are going to investigate simulator tool for underwater acoustic channel. In chapter 2, channel simulator and the result will be shown and in chapter 3, conclusion will be written.

2 Channel simulator and execution result

Simulator is composed of 3 main blocks which are input parameter block, calculate LOS signal group block and calculate NLOS signal group block. In input parameter block, we must put sensor position, receiver position, water height and distance between sensor and receiver. In process LOS signal group block, LOS signal based processing is performed that is, signal is not bounded at bottom or surface of water and it is reached at the receiver. In calculate NLOS signal group block, at first signal is bounded at bottom or surface and it navigate into receiver. In the receiver, valid signal is counted and its signal strength and delay time is recorded. This simulator is implemented using C language. Figure 1 shows that simulator running screen and its flow diagram.

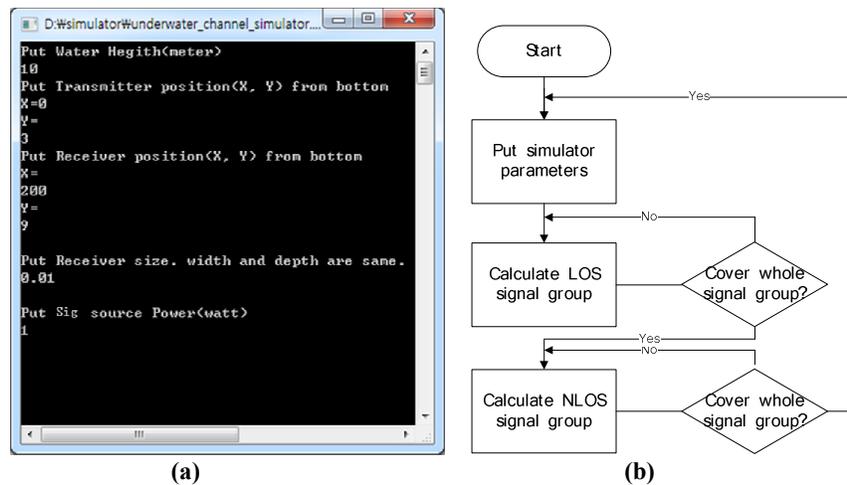**(a)**   **(b)**

Fig. 1. Simulator : (a) Running screen and (b) processing flow diagram

Using this tool, we performed acoustic channel simulation of underwater. Channel circumstance was supposed as follows : water height is 10m, sensor position is 3m upper from bottom, receiver position is 9m from bottom and distance between sensor and receiver is 200m. As a test result, output text file was created for recording channel characteristics. After post processing this file, we finally got delay-attenuation graph as shown in figure 2-(a) and it's numeric value was shown in figure 2-(b). After receiving LOS signal, multiple bounded signals are received, which can cause multiple path fading. In order to overcome this situation, appropriate modulation technique can be used like spreading or OFDM and at this moment, these reliable channel characteristics will be very helpful.
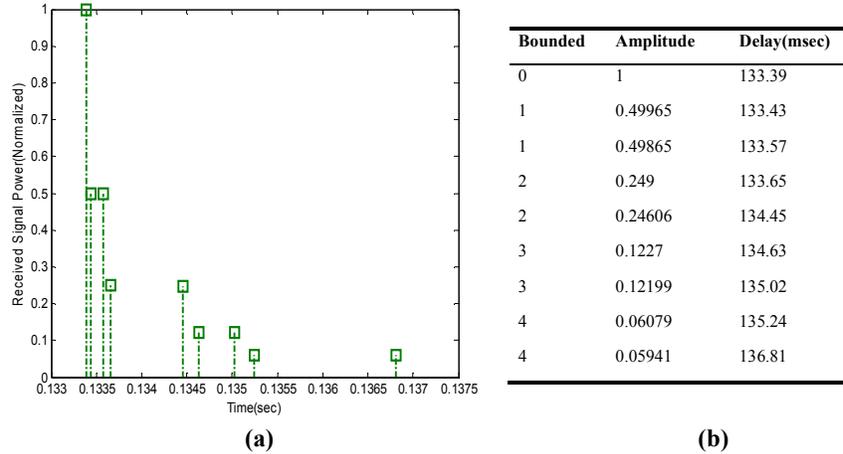
Bounded	Amplitude	Delay(msec)
0	1	133.39
1	0.49965	133.43
1	0.49865	133.57
2	0.249	133.65
2	0.24606	134.45
3	0.1227	134.63
3	0.12199	135.02
4	0.06079	135.24
4	0.05941	136.81

(a)   **(b)**

Fig. 2. Simulator test result: (a) Multiple received signal characteristics and (b) numeric value

3   Conclusion

In this paper, we were shown in predefined circumstance to simulator for underwater acoustic channel was studied and the test result. Therefore, this tool is able to be applied at any underwater circumstance where channel characteristics should be investigated for sending sensing data of wastewater.

References

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