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Realization of environmental performance surface for effective deployment of underwater sensor network node

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1. Introduction

Recently, Underwater acoustic sensor networks (UW-ASN) are interesting beacause it is available to civillian demand such as ocean environmental monitoring, resource observation and military demand such as detection, unmanned undersea vehicle, information gathering of ocean. Also, study on efficient deployment of sensor nodes is proceeding ativley.

In generally, conventional studies on sensor networks have been conducted in terrestrial environment and most of these studies have no regard for the various factors of environment that effects of performance of sensor networks. However, considering factors of environment is very important for stability connection of network and efficient deployment of sensor node because communication performance coverage of sensor networks is greatly influenced by environment. Recently, some studies were attempted to consider factors of environment. In these studies, factors of environment give weight coefficient from 0 to 1 for calculation of sensor node coverage. However, the limit of this method is that the computation process of the weight coefficient is not clear.

In this paper, environmental performance surface model is proposed for stability connection among sensor nodes.

2. Performance Surface model

Vertical sound speed structure, depth of water, submarine topography and constituent of sea bottom are factors of the environment that affects performance of sensor networks. Vertical sound speed structure is affected by water temperature, hydraulic pressure, salinity, and etc. Especially water temperature is dominant factor for determining vertical sound structure. Therefore vertical sound structure is factor of timely environment. Depth of water, submarine topography and constituent of sea bottom are factors according to its place. Therefore, these factors are factor of spatial environment. Environment data base is collected to describe factors of time-space environment. GDEM is applied for monthly vertical sound speed structure. Data of NODC (NOAA National Geophysical Data Center) is used for depth of water and submarine topography. Core data surveyed by KIOST (Korea Institute of Ocean science & Technology) is used for constituent of sea bottom.

Collected data is used for input parameter for bellhop simulation. Channel impulse response and transmission loss are extracted by bellhop simulation applied factor of environment. **Fig.1** shows the channel impulse response and transmission loss.

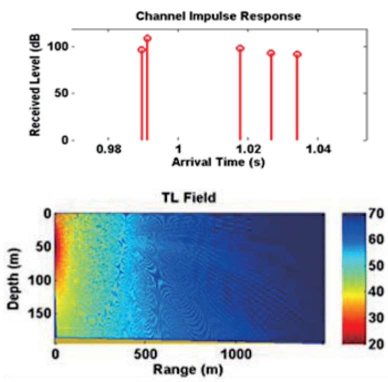

Fig. 1 Channel impulse response and transmission loss by Bellhop simulation

SNR is calculated by using the eq. 1 shown below

$$SNR = SL - TL - N \quad (1)$$

where, SL is the source level and N is the noise level by Wenz curve. TL is the transmission loss extracted by bellhop simulation.

SNR and channel impulse response are used as the input parameters for acquisition of communication performance. Communication performance can be predicted by extracting BER from the estimation algorithm of the communication performance because BER is the criterion of performance for digital communication.

Target of the sea is selected and point of sampling is selected for realization of performance

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surface. And then range resolution and azimuth range are selected. Above process is conducted for each point, each range and each azimuth. Simulated BER is modified to BNER by eq. 2.

$$BNER = 1 - BER \quad (2)$$

Fig.2 show the BNER with range and maximum capable communication range for threshold BNER.

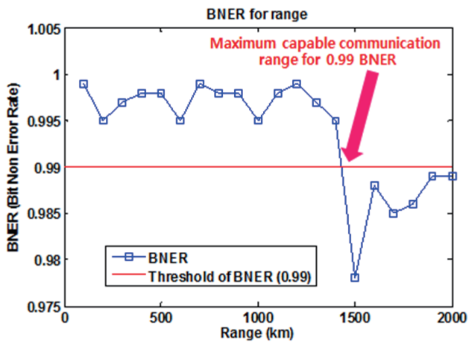

Fig. 2 BNER (Bit Non Error Rate) for range and maximum capable communication range

Calculation process of maximum capable communication range is repeated for every azimuth of every sampling point. Maximum capable communication range is averaged for each azimuth. At this point, each sampling point has single data of maximum capable communication range. Sampling point is increased by interpolation method. Performance Surface model is represented by plotting the value of interpolated sample point on coordinate.

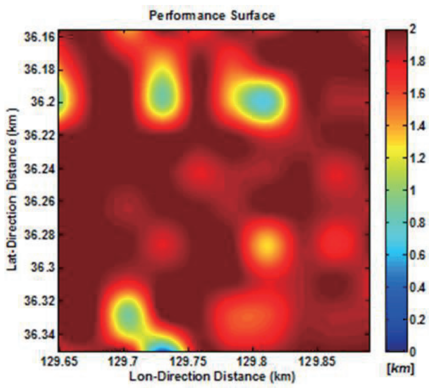

Fig. 3 Performance surface model for communication coverage of sensor node

4. Conclusions

In this paper, realization process of environmental performance surface model to simulate performance of UW-ASN is proposed. Performance surface model is considered for environmet factor of real sea. Therefore, stability connection among sensor nodes is increased by using the peroformance surface model for deployment of sensor node.

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