1H06

Coaxial-like Transmission Line Model in Seawater Propagation

○ Jialu Wang*, Qiang Chen*

Dept. of Communications Engineering, Tohoku University, Japan*

Abstract — Some infrastructures present in the seawater can be considered as a type of transmission line that allows electromagnetic (EM) waves transmission loss lower than directly in seawater. The efficiency is evaluated in terms of the transmission factors. It is shown that the reflection on the surface of the transmission line reduces the coupling between the EM waves and the transmission line.

Keyword — Coaxial transmission line, Transmission factor, Seawater propagation.

1. Introduction

EM waves are expected to wirelessly transmit information to ground stations through the drone in seawater, facilitating inspections of undersea infrastructures. However, EM waves propagation in seawater suffers an extremely large proportion loss due to the high conductivity of seawater.

In this report, some underwater infrastructures is considered capable of forming a coaxial-like line model with seawater, thereby reducing transmission losses. The transmission loss is evaluated using a transmission factor [1]. HFSS is utilized as simulation software, where working frequency f is 30 MHz and the length L of the dipole antenna used is 20 mm.

2. Transmission model and simulation results

The calculation formula of transmission factor (τ) is as follows [1]:

$$\tau = \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)} \quad (1)$$

Since the underwater portion of the wind turbines take the shape of a pipeline and are filled with seawater both internally and externally. It forms a coaxial-like line model, which is shown in Fig.1.

Transmit T_x and receive R_x dipole antennas are placed in the seawater outside the coaxial-like line model, as shown in Fig.1. To assess the scatter and the internal transmission effect of the model on transmission efficiency, R_x is embedded within the model.

The simulation results are illustrated in Fig.2.

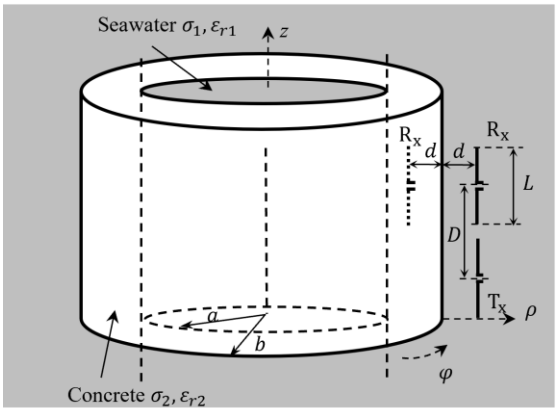

Fig.1. The coaxial-like line transmission model.

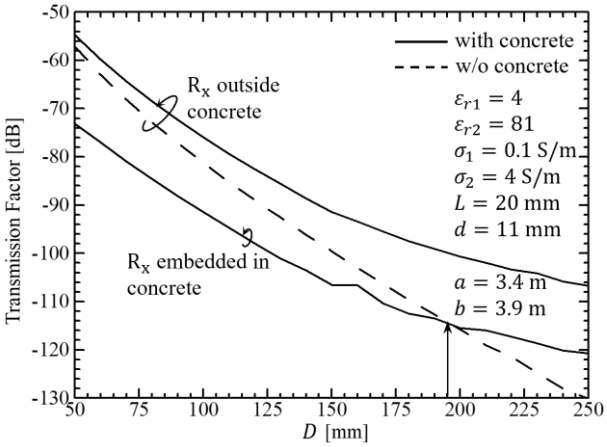

Fig.2. Simulation results.

3. Conclusion

The demonstrated coaxial-like line model is believed to reduce the transmission loss in seawater. The reduction mainly comes from the scattering from the outer wall of the model probably. The intersection point indicates that EM waves is coupled into the model, while the reflection reduces the coupling between the antenna and the transmission line.

Acknowledgement

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References

[1] Q. Chen, et al, "Antenna Characterization for Wireless Power-Transmission System Using Near-Field Coupling," *IEEE Ante. Prop. Maga.*, **54**, 4, 108-116, (2012).