The Model for Equivalent Circuit of Electric Field Sensor Onboard Satellite in Space Plasma

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1. Introduction

Knowledge of the characteristics of wire antennas in space plasma used as sensors for electric field observations by scientific satellites in geospace is necessary to determine the absolute intensity and the phase of the electric field wave because the observation data about electric field are available as voltage signal. Two important characteristics are the effective length and the antenna impedance. Determination of the impedance can be especially difficult since the impedance depends on the medium surrounding the antenna, and the impedance is affected primarily by the plasma sheath created around the antenna.

2. Previous Study

The impedance of the antennas onboard Geotail was measured by Tsutsui et al.[1] by using the calibration function onboard Geotail where a modulated square wave test signal was applied to the antenna elements. They found that the impedance depended mainly on the electron density and the satellite spin. The dependences of the impedance measurement on the satellite spin are caused by the fluctuation of the photoelectron emissions from the antenna surfaces.

On the other hand, the impedance onboard Akebono was measured by Hashimoto et al.[2], where the results also depended on the electron density and the satellite spin. However the photoelectrons do not play an important role in the impedance measurement, because the spin axis of Akebono always points to the sun.

3. Results

In this study, according to more closely analysis of measurement results of the antenna impedance on Akebono, the dependence on the angle between the antenna and the direction of satellite movement were found. Furthermore, the dependence on the wave frequency of the resistance component of the impedance was found. Previous study, the observation data of the electric field was calibrated by using the antenna impedance which was assumed as constant. We will discuss about the fixed model considering these results about the antenna impedance.

7. References

[1] M. Tsutsui, I. Nagano, H. Kojima, K. Hashimoto, H. Matsumoto, S. Yagitani, and T. Okada, “Measurement and analysis of antenna impedance aboard the Geotail spacecraft,” *Radio Sci.,* **vol.32**, 1997, pp. 1101-1126.

[2] K. Hashimoto, I. Nagano, T. Okada, M. Yamamoto, and I. Kimura, “Antenna vector impedance measurement by the EXOS-D (Akebono) very low frequency plasma wave instrument (VLF),” *Geophys. Res. Lett.,* **vol.18**, 1991, pp. 313-316.