

Comparison between Capsule Dipole and Capsule Loop Antenna on Transmission Characteristics through Human Body

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1. Introduction Ingestible capsule endoscope systems is expected for healthcare applications. In order to evaluate the antenna characteristics inside the human body, it is necessary to evaluate both the impedance of antennas and the transmission characteristics inside and outside of a human body. In this report, the input impedance, the transmission factor of a capsule dipole antenna and a capsule loop antenna through the human body are compared.

2. Analysis model Torso model of real human body made by MRI image with 76 kinds of organs developed by SPEAG Co.Ltd was used in the FDTD simulation. The analysis model is shown in Fig. 1. A capsule dipole antenna or a capsule loop antenna was located in the stomach and the corresponding receiving antenna was located outside with a distance of 74 mm. Frequency characteristics of the relative permittivity and the conductivity of 76 organs provided by ITIS [1] were used in the frequency dependent FDTD method. The transmission factor [2] was evaluated which is corresponding to the received power under the complex conjugate matching conditions satisfied at both transmitting and receiving ports.

3. Results Frequency characteristics of input impedance in cases of a capsule dipole antenna and a capsule loop antenna were shown in Fig. 2. It is observed that the resistance slightly increases as the frequency decreases in the case of capsule dipole, while the resistance close to zero as the frequency decreases. The transmission factor τ was shown in Fig. 3. It is found that a local maximum is appeared around 400 MHz in case of the capsule dipole antenna. On the other hand, τ increases as the frequency decreases in the case of capsule loop antenna and quite high value of -11.2 dB at 100 MHz was observed. The value of transmission factor is larger than that of dipole antenna because the magnetic-type loop antenna leads to less transmission loss through human body in low frequency.

4. Conclusion In this report, the transmission characteristics of capsule dipole or capsule loop antenna located in the digestive system of a human body were presented.

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[1] www.itis.ethz.ch/database

[2] Q. Chen et.al, IEEE Trans. Antennas Propag. Magazine, vol. 54, pp. 108-116, Aug. 2012.

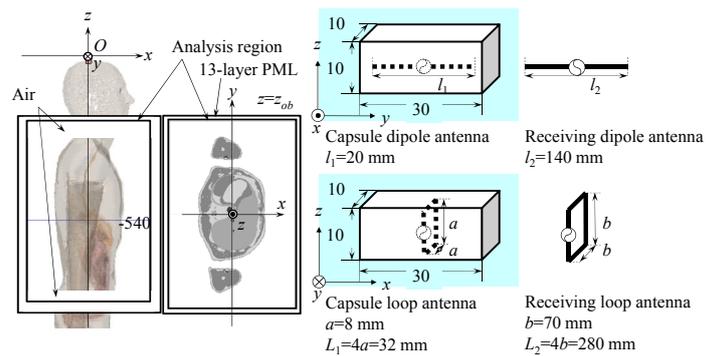


Fig. 1. Analysis model.

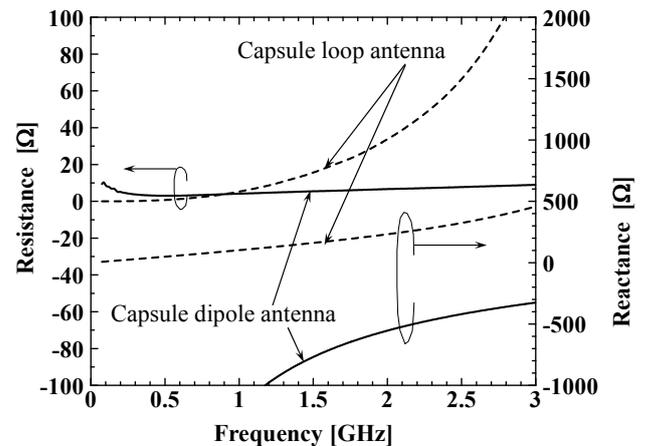


Fig. 2. Frequency characteristics of input impedance.

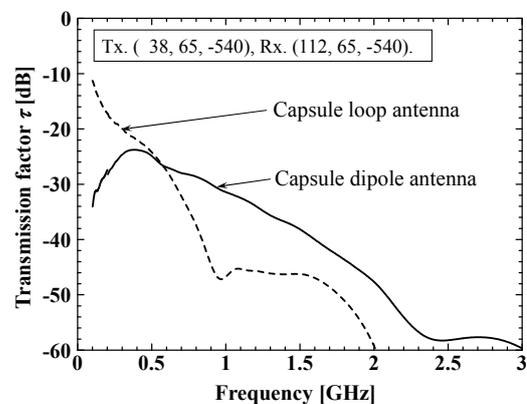


Fig. 3. Frequency characteristics of transmission factor through stomach of human body.