RCS calculation of the human body for a phantom of human body detection at 5.7 GHz

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Spatial transmission type WPT (Wireless Power Transmission) is a WPT method that wirelessly supplies power to equipment from an antenna using electromagnetic waves. Compared to other WPT methods, it has the advantage of a long transmission distance, but has the disadvantages of low transmission power and efficiency. In addition to this problem, it is also necessary to protect human body, so the human body avoidance technology is required. This technology detects the human body on the power transmission path and change the power transmission direction. Since it is difficult to use an actual human body in developing this technology, it is necessary to develop a phantom that replaces human body. The phantom does not need to accurately reproduce the shape and physical properties of the human body, but it must be an object with an RCS (Rader Cross Section) equivalent to that of the human body. In addition, it is desired to be lightweight so that it can be easily handled. For this reason, we are developing a simple and lightweight phantom for human body detection.

The RCS of the human body changes depending on posture, belongings, gender, body shape, etc. Therefore, in this study, we calculated the RCS of various human body models at 5.7 GHz, set the target range of the RCS of the simple lightweight phantom from the RCS variability.

Assuming that the transmitting antenna is installed on the ceiling, we analyzed using the male human body model (Male 1) developed by the National Institute of Information and Communications Technology (NICT), Tokyo, Japan [1]. Simulation model is shown in Fig. 1. The monostatic RCS in the direction of 96 grid points obtained in 15° increments at θ = 15° to 60° and ϕ = 0° to 360° was calculated (grid points in Fig.1). For the analysis, planarly polarized waves vibrating in the E_θ direction of 5.7 GHz were used. The cell size is 2×2×2 mm^3, and the analysis method is the FDTD (Finite Difference Time Domain) method.

The RCS was calculated in the same way for five human body models with different postures, genders, belongings, and body shapes, and the differences from the RCS of Male 1 were taken at all grid points. For Fig. 2 (a) to (c), the human body model developed by NICT was used as in Male 1. For (d) and (e), the human body model developed by the IT'IS Foundation was used [2].

From in Fig. 2, in all models, the RCS of 75% or more grid points was within ± 10 dBsm of RCS of Male 1. From this, the RCS of the phantom should be within ± 10 dBsm of the RCS of Male 1. In the future, we are considering the development of a simple and lightweight phantom.

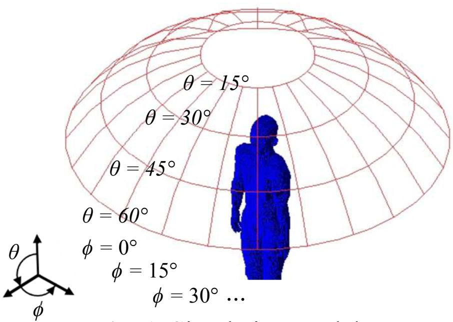

Fig. 1. Simulation model

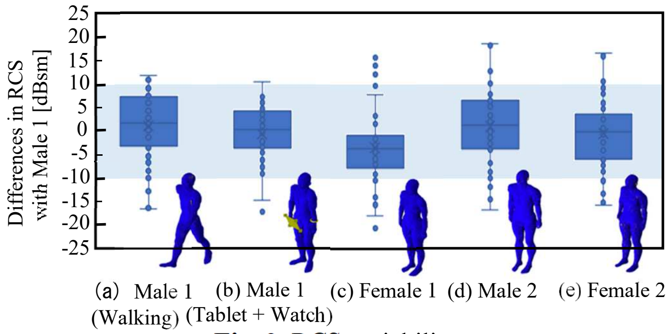

Fig. 2. RCS variability

References

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