URSI GASS 2020, Rome, Italy, 29 August - 5 September 2020

A Verification of an Uncertainty of a Specific Absorption Rate Measurement for Last Five Years

Yuto Shimizu (1), Nozomu Ishii (1)(2), Tomoaki Nagaoka (1), Kanako Wake (1) and Soichi Watanabe (1)
(1) National Institute of Information and Communications Technology,
4-2-1, Nukuikitamachi, Koganei, Tokyo, 184-8795, Japan, e-mail: y_shimizu@nict.go.jp
(2) Faculty of Engineering, Niigata University, 8050, Ikarashi 2-no-cho, Nishi-ku, Niigata, 950-2181, Japan

In recent years, wireless communication devices have been widespread. Wireless communication devices used near a human body need to be assessed for human exposure. For instance, in a frequency band from several MHz to 6GHz, SAR (specific absorption rate) is used as the safety criteria [1]. The compliance test procedure is standardized by IEC (International Electrotechnical Committee) [2][3]. In the compliance test, to guarantee the SAR measurement result, the uncertainty evaluation for the measurement is important. Evaluation methods for each uncertainty sources are also defined in the IEC documents [2][3]. We have evaluated the SAR measurement system uncertainty based on the IEC standard every year. In this study, we observed the yearly change of uncertainties for last five years, and also revealed the dominant sources of the SAR measurement uncertainty.

Figure 1 shows the yearly change of the expanded uncertainties in several frequency bands for five years. It is noted that the evaluation methods of some uncertainty sources vary from year to year. From this figure, the uncertainties in each frequency indicate same tendency against the yearly change. Focusing on the yearly change of the expanded uncertainties the results of 2018 are better than the previous year. Because, in 2018, we reconsidered the evaluation method for the uncertainty of the dielectric property measurement for the human-tissue equivalent liquid. Therefore, the uncertainty of dielectric property measurement was reduced from around 3 % to 0.5 % in all frequencies. Additionally, the result of 1450 MHz in 2016 shows different tendency from the other frequencies. This result was caused by a high uncertainty in the detection limit at 1450 MHz. Next we analyzed dominant uncertainty sources. Table 1 lists the main uncertainties of 1950 MHz in 2018. From this table, the detection limit, and probe calibration are deemed as dominant sources of the uncertainty. These dominant sources can also be seen in the other frequencies. As you can see from the yearly change, it is clear that the detection limit affects the expanded uncertainty. In addition, the yearly change of the probe calibration uncertainty shows the same tendency as that of the expanded uncertainty. From this reason, the probe calibration and detection limit are important sources to improve the SAR measurement uncertainty.

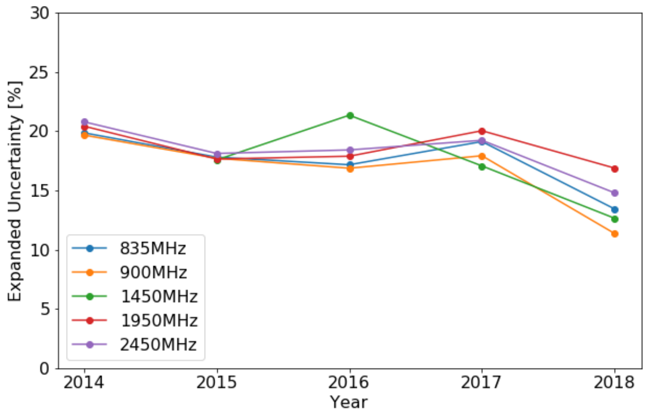

Figure 1. Expanded uncertainty of SAR measurement system

Table 1. Uncertainty budget at 1950 MHz in 2018

Source of uncertainty	Uncertainty [%]
Probe calibration	3.8
Probe isotropy	1.9
Probe linearity	1.6
Detection limit	5.6
Post processing	1.6
Deviation of experimental source	1.1
Input power	1.1
Other uncertainty contributions of source	2.3
Phantom shell	2.4
Combined uncertainty	8.4
Expanded uncertainty (k=2)	17

References

[1] ICNIRP, *Health Phys.*, vol. 74, no. 10, pp. 494-522, 1998.
[2] IEC 62209-1, 2016.
[3] IEC 62209-2, 2011.