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Effectiveness of Measurement Reduction Techniques for SAR Assessment in 5G FR1 Smartphones

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In recent years, wireless communication devices have become widespread. When used near the human body, these devices must be assessed for human exposure. The SAR (specific absorption rate) is used to assess human exposure from wireless communication devices in the frequency range from 700 MHz to 6 GHz used for mobile communications [1]. The conformity assessment procedure is provided by the International Electrotechnical Commission (IEC) [2]. This assessment is performed for all combinations of frequencies and modulation schemes available in wireless devices. As the number of available frequencies and modulation schemes in wireless devices has been increasing, this has resulted in a huge number of measurements. Therefore, standard [2] provides methods to reduce the number of measurements. The authors have previously confirmed the effectiveness of this reduction method for 4G long term evolution (LTE) [3]. In this study, we verify the effectiveness of this method for 5G frequency range (FR) 1 band, which has become increasingly popular in recent years.

To verify the reduction method, SAR measurements were conducted using three commercially available smartphones with 5G FR1 band capability. The measurements were performed using a head phantom in all 5G FR1 frequency bands available for each smartphone. The measurement positions of head phantom were left and right cheek and tilt positions. The total number of measurements for each smartphone ranged from twenty-four to fifty-six. Subsequently, a reduction method based on antenna location was applied to the SAR measurement results. This reduction method can eliminate measurements in the tilt position when the antenna is within 25 mm from the bottom of devices. Figure 1 shows the number of measurements required using the reduction method compared exhaustive measurement. The figure demonstrates that the number of measurements was reduced by 63-75 % compared to the exhaustive measurement. This reduction was slightly lower than that achieved for LTE. The reason is that antennas used in 5G FR1 band communications are often located at the top of smartphone, and the effectiveness of this method, which can effectively reduce the number of measurements, is not demonstrated when the antennas are located on the bottom of the device. However, the maximum average local SAR and the measurement conditions under which it was obtained were consistent with those of the exhaustive method even when the reduction method was applied, confirming the effectiveness of the method for reducing the number of measurements. In the presentation, results when other reduction methods are applied will also be shown.

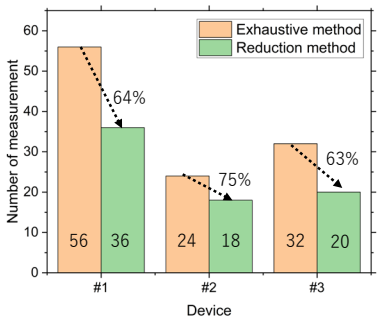

Figure 1. Number of measurements in reduction method and exhaustive measurement

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1. ICNIRP, *Health Phys.*, vol. 118, no. 5, pp. 483-524, Mar. 2020.
2. IEC/IEEE 62209-1528
3. Y. Shimizu, et.al., BioEM2023, A56, p.78, Jun. 2023.