3[rd] URSI AT-AP-RASC, Gran Canaria, 29 May – 3 June 2022

Comparison of Exposure to Electromagnetic Fields at 28 GHz on Temporal Head Surface Between the Reference and Anatomical Models: A Simulation Study

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With the expansion of technologies using quasi-millimeter and millimeter waves, such as 5G systems, in the general environment, the public concern regarding human exposure to electromagnetic fields (EMFs) has increased. Thus, it is essential to assess human exposure to EMFs from these wireless systems. The spatial average of incident power density over an area of 4 cm^2 that is incident to a human body is used as a metric of the reference levels for local exposure to EMFs above 6 GHz in the exposure guideline published by ICNIRP [1]. Wireless devices such as mobile phones are used near a human body; therefore, power densities proximity to the devices should be evaluated to assess compliance to the reference levels. IEC/TC106 and IEEE/ICES/TC34 provide international standards of compliance assessment procedures by measurement [2] and computational [3] approaches. In these (draft) standards, an evaluation surface of head shape (herein after referred as 'the reference model') has been specified; this evaluation surface is adopted in the case of a device held near the ear. The dimensions of the reference model are based on the average dimensions of the adult human head for the assessment of local power absorption referred to as the peak spatially averaged specific absorption rate (psSAR), which is a metric of human exposure to EMFs up to 6 GHz [4]. Although the applicability of the reference model for the assessment of psSAR has been investigated at several frequencies, particularly at frequencies used in mobile communications, that for the assessment of incident power density has not been thoroughly investigated.

From the viewpoint of compliance assessment, in this study, we compare the peak spatial average of incident power density on the temporal head surface between the reference model [2] and the anatomical human model [5]. Around 80 exposure scenarios with different patch array antenna positions and beam steering conditions were considered, assuming the use of a 5G smartphone operating at 28 GHz. The distributions of incident power density on each head model were also evaluated by electromagnetic simulation. The results showed that the reference head model statistically simulates the exposure level of the anatomical human model of a Japanese male in the considered exposure scenarios.

This work was supported by the Ministry of Internal Affairs and Communications under Grant Number JPMI10001.

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