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Traceable Absorbed Power Density Assessment System in the 28 GHz Band

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ICNIRP and IEEE closed a critical gap in the safety guidelines by introducing a basic dosimetric restriction above 6 GHz. These are the absorbed power density (APD) and the spatial average power density. In previous work by our group, a phantom, and a compatible probe were developed to measure the APD in the 5G new radio frequency range 2 (NR FR2; 24–30 GHz) [1]. Here, a probe calibration procedure and an experimental validation procedure for the proposed phantom are detailed.

The validation is based on comparing the phantom's reflection coefficients from different excitation sources to the stratified human skin model. The reflection coefficient was measured with one of the sources in contact with the phantom shell. The source was then moved away, and the reflection coefficient was recorded at different distances. This procedure was repeated for the other sources. The finite-difference time-domain solver in Sim4Life (ZMT Zurich MedTech AG, Switzerland) was used to obtain the target values for this experiment. The measurements and simulations were compared based on cosine similarity; a metric not affected greatly by the sharpness of the resonance.

A setup based on the multi-mode solution for a rectangular waveguide radiating into a dielectric half-space was developed for calibrating the novel APD probe. A schematic of the calibration setup is shown in Figure 1. A cylindrical container fed by an open-ended rectangular waveguide holds the tissue-simulating liquid (TSL). Measurements are carried out along the Z-axis in the center of the container. The field profile of the propagating mode is obtained analytically by formulating the fields in the rectangular waveguide and the dielectric medium and matching them at the intersection. A reflection coefficient based correction factor is computed to account for the discrepancies caused due to fabrication imperfections. The calibrated electric field is obtained by linearly scaling the uncalibrated probe response to match the calculated field profile.

The results of this research validate the first APD measurement system designed for the 5G NR FR2 band (24–30 GHz). The results of routine compliance tests with this new APD system compared to incident power density evaluations of commercial sources will be presented together with the final uncertainty budget.

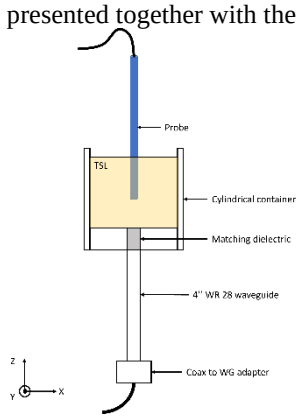

Figure 1. Schematic representation of the APD probe calibration setup.

References

[1] F. Karimi *et al.*, "Method and Implementations to Measure the Absorbed Power Density," in *2022 IEEE MTT-S International Microwave Biomedical Conference (IMBioC)*, Suzhou, China, May 2022, pp. 129–131. doi: 10.1109/IMBioC52515.2022.9790128.