Wearable Shell Antenna for 2.4 GHz Hearing Instruments

A novel concept for an electrically-small on-body antenna targeted for 2.4 GHz ISM band custom in-the-ear (ITE) hearing instrument (HI) applications is introduced. The antenna is based upon a cavity-backed design in order to take advantage of the maximum volume available in the ear while providing isolation from the user’s body, and it occupies only 40% of the volume of the sphere with radius $a = 12$ mm. The antenna is implemented on a realistic 3D-printed lossy substrate and exhibits high efficiency of 70% and 22%, and a 6-dB impedance bandwidth of 108 MHz and 149 MHz, when the antenna is measured in free space and ITE, respectively. A measurement campaign conducted in free space and on a specific anthropomorphic mannequin (SAM) head with ears shows that the radiation pattern is optimal for HI applications. Furthermore, the antenna is primarily polarized normal to the surface of the head to ensure the best on-body path gain. This is substantiated by the study of the ear-to-ear (E2E) path gain, which is measured and compared to analytic and numerical results.

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