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Improvement in Acoustic Performance at Low Frequency via Application of Acoustic Resistance of Vented Hole in In-Ear Earphones

Authors : Tzu-Hsuan Lei, Shu-Chien Wu, Kuang-Che Lo, Shu-Chi Liu, Yu-Cheng Liu

Abstract : The focus of this study was on the effects of air propagation associated with vented holes on acoustic resistance properties. A cylindrical hole with diameter and depth of 0.7 mm and 1.0 mm, respectively, was the research target. By constructing a finite element analytical model of its sound field properties, the acoustic-specific airflow resistance relationships were obtained for the differences in sound pressure and flow velocity at the two ends of this vented hole. In addition, the acoustic properties of this vented hole were included in the in-ear earphone simulation model to complete the sound pressure curve simulation analysis of the in-ear earphone system with a vented hole of corresponding size. Then, the simulation results were compared with actual measurements obtained from the standard system. Based on the results, when the in-ear earphone vented hole simulation model considered the simulated specific airflow resistance values of this cylindrical hole, the overall simulated sound pressure performance was highly consistent with that of measured values. The difference in the first peak values of sound pressure at mid-to-low frequencies was reduced from 5.64% when the simulation model did not consider the specific airflow resistance of the cylindrical hole to 1.18%, and the accuracy of the overall simulation was around 70%. This indicates the importance of the acoustic resistance properties of vented holes. Moreover, as specific airflow resistance values were able to be further quantified, the accuracy of the entire in-ear earphone simulation was ultimately and effectively elevated.

Keywords : specific airflow resistance, vented holes, in-ear earphone, finite element method
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