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**Numerical Analysis of the Effects of Pinna Shape and Position on  
the Characteristics of Head-Related Transfer Functions**

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There are distinctive notches and peaks in Head-Related Transfer Functions (HRTFs). Some of them are considered as important cues in the perception of the elevation angle and thus the roles of these peaks and notches should be clarified. It is known that the characteristics of HRTFs are deeply related to listener's anthropometry. It is thus naturally expected that frequencies of the peaks and notches also change according to the individuality of listeners' anthropometry. Therefore, in this study, effects of ear shapes and positions on frequency positions of the peaks and notches are examined by numerical analyses. The analysis was performed with boundary element method (BEM). A three-dimensional model of a dummy-head was constructed with a three-dimensional laser scanner and HRTFs of the model were numerically computed with a BEM solver. The model was modified on some features as follows: 1) pinna position, 2) pinna size, 3) angle of pinna toward listener's head, and 4) existence of wrinkles of pinna. HRTFs of the modified models were also computed. From the comparison among the results of calculation, several systematic changes were found. For example, the frequency position of notches around 8 kHz is shifted toward lower frequency as the size of pinna increases.