Influence of interaural time differences on the loudness of low-frequency pure tones at varying signal and noise levels
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The effect of room acoustics on speech intelligibility and spatial release from masking, Thomas Biberger and Stephan D. Ewert (Medizinische Physik and Cluster of Excellence Hearing4All, Universität Oldenburg, Carl-von-Ossietzky-Straße 9-11, Oldenburg, Lower Saxony 26135, Germany, thomas.biberger@uni-oldenburg.de)

In daily life, verbal communication often takes place in indoor situations with interfering sounds, where speech intelligibility (SI) is affected by (i) masking and (ii) reverberation. Both introduce spectral and temporal changes to the sound. A critical spatial configuration to assess (binaural) SI is a frontal target speaker and two interfering sources symmetrically placed to either side (± 60°). Here a spatial release from masking (SRM) is observed in comparison to co-located frontal target and interferers, showing that the auditory system can make use of temporally fluctuating interaural differences. Room reverberation affects the temporal representation of the target and maskers and, moreover, the interaural differences depending on the spatial configuration and room acoustical properties. Here the effect of room acoustical properties (room size, T60, frequency dependency of T60), temporal structure of the interferers, and direct to reverberation ratio (DRR) on speech reception thresholds (SRT) and SRM were systematically assessed in a simulated room using headphone-based virtual acoustics. For constant T60 and DRR a different room size resulted in, e.g., significantly different SRTs but similar SRMs, implying the temporal structure of reverberation is less relevant for exploiting binaural cues.

Psychological and Physiological Acoustics: Sound Localization and Binaural Hearing

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Contributed Papers

5aPPb1. Influence of interaural time differences on the loudness of low-frequency pure tones at varying signal and noise levels. Gauthier Berthomieu, Vincent Koehl, and Mathieu Paquier (Lab-STICC UMR 6285, Univ. of Brest, 6 Ave. Le Gorgeu, Brest 29200, France, gauthier.berthomieu@univ-brest.fr)

Directional loudness sensitivity, which is generally accounted for by at-ear pressure modifications because of the perturbation of the sound field by the head, has been reported to occur at 400 Hz where shadowing effects are usually considered small. Then, an effect of the interaural time difference (ITD) on loudness has been observed for pure tones below 500 Hz. The latter was rather small but still significant, contributing to directional loudness sensitivity. In addition, it has been shown that the effect of ITD on loudness was caused by the ITD itself and not by its related localization. As this effect appeared significant at low level only (40 phon), it was hypothesized that ITD could help separate the signal from the internal noise and enhance its loudness. The aim of the present study is to confirm this hypothesis by observing the effect of ITD on the loudness of low-frequency pure tones (100 and 200 Hz) for various signal-to-noise ratios. The signal level was varied from 30 to 90 phon and the noise could be internal only or external also. The effect of ITD appeared significant up to 40 or 50 phones depending on the frequency.

5aPPb2. Computational study of head geometry effects on sound pressure gradient with applications to head-related transfer function. Mahdi Farahkia and Quang T. Su (Mech. Eng., SUNY Binghamton, 13 Andrea Dr. Apt. A, Vestal, NY 13850, mfarahi1@binghamton.edu)

Effects of object geometry on sound scattering of far-field incident sound waves for two different head models (spherical and ellipsoidal) have been studied using an optimized Finite Element Method (FEM) based on frequency-dependent adaptive dimensions. This optimized FEM technique is proven both efficient and accurate when compared with analytical results for the spherical model, with maximum deviation of 0.6 dB. Comparisons between models have been made on the equivalent Head-Related Transfer Functions (HRTFs) for acoustic pressure, and for the first and second order pressure gradients on the surface. It is shown that while directionality cannot be achieved at lower frequencies using only pressure, pressure gradients provide sound cancellation for certain source orientations. Hence, it is possible to cancel incoming sound from the front (or behind) or sides depending on the direction (radial, azimuthal) and order of pressure gradients. While the pattern of pressure gradient directionality remains similar between the spherical and ellipsoidal models, the difference in dimensions affects the amplitude of the equivalent HRTFs for these parameters. This study provides insight into the placement of directional microphones on the head for hearing aids.