Influence of interaural time differences on the loudness of low-frequency pure tones at varying signal and noise levels

Gauthier Berthomieu, Vincent Koehl, Mathieu Paquier

11:40

5aPPa11. 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 signal. 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. Data are discussed and compared to predictions of a binaural SI model.

12:00

5aPPa12. On the relationship between a short-term objective metric and listening efficiency data for different noise types. Nicola Prodi and Chiara Visentin (Dipartimento di Ingegneria, Università di Ferrara, via Saragat 1, Ferrara 44122, Italy, nicola.prodi@unife.it)

This study aims to compare the distinct effects of a steady-state (SSN) and a fluctuating (ICRA) masker on speech reception performance. SNR, reverberation and masker type were combined as to create several acoustic scenarios; matrixed-word listening tests in the Italian language were proposed to a panel of young adults with normal hearing, collecting data on intelligibility scores (IS) and response time (RT). The listening conditions were objectively qualified with the short-term metric STIr, defined as the average of the STI values calculated over short time-windows, whose duration reflects the typical phoneme length. The results showed that for a given STIr, both maskers yield the same IS, being the fluctuation benefit already accounted for by the objective metric. The slope of the STIr-IS function only depends on the speech material. Anyway, the fluctuating masker calls for an increased amount of cognitive resources to be deployed in the speech reception process, traced by a statistically significant higher response time. These results shade a new light on the fluctuating masker release (FMR) phenomenon.

THURSDAY MORNING, 29 JUNE 2017 ROOM 300, 8:00 A.M. TO 12:20 P.M.

Session 5aPPb

Psychological and Physiological Acoustics: Sound Localization and Binaural Hearing

Griffin D. Romigh, Chair
Air Force Research Labs, 2610 Seventh Street, Area B, Building 441, Wright Patterson AFB, OH 45433

Contributed Papers

8:00

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.

8:20

5aPPb2. Computational study of head geometry effects on sound pressure gradient with applications to head-related transfer function. Mahdi Farahikia 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.