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Evaluation of artificial head recording systems

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have been carried out worldwide to verify the synthesis technique, and only a few seem to have obtained satisfactory results. In the present paper the results from contemporary studies (including the authors own) are presented and discussed.

3:15

1pPP6. Evaluation of artificial head recording systems. Henrik Møller, Clemen Boje Jensen, Dorte Hammershøi, and Michael Friis Sørensen (Acoust. Lab., Aalborg Univ., Fredrik Bajers vej 7B, DK-9220 Aalborg Ø, Denmark)

Artificial head (or dummy head) recording and playback systems are increasingly used. The main advantage of these systems is their ability to reproduce three-dimensional spatial aspects of sound. However, the exact reproduction of direction has been questioned from time to time. The study presents an objective and subjective evaluation of eight artificial heads. In the objective test, the head-related transfer functions of the heads were compared to those of humans. Significant deviations were seen for all heads, and none of them can be characterized as a mean, median, or typical head. In the subjective test a panel of listeners indicated direction and distance to sound sources recorded by the head and reproduced by means of carefully equalized headphones. The reproduction of direction was in general poor, especially in the median plane.

3:30

1pPP7. Auditory localization of a nearby point source. Douglas S. Brungart, William M. Rabinowitz, and Nathaniel I. Durlach (Res. Lab. of Electron., MIT, 77 Massachusetts Ave., Cambridge, MA 02139)

Although human auditory localization has been studied extensively in the past century, little is known about the localization of nearby sound sources. The head-related transfer function (HRTF) contains all relevant localization information and has been thoroughly examined for relatively distant sources, but may exhibit unique properties in the "near-field" region within 1 m of the center of the head. A rigid-sphere computational model of the head has been used to estimate near-field HRTFs, and a KEMAR manikin and a specialized acoustic "point" source have been used to measure HRTFs for sources as close as 0.25 m. For a fixed source direction, the interaural time delay is roughly independent of distance, but the interaural amplitude difference increases dramatically as the source approaches within 1 m of the head. When the source is near one ear, the interaural amplitude difference exceeds 20 dB across the audio spectrum. The differences between near-field and more distal HRTFs will be discussed, including comments on how near-field effects may facilitate three-dimensional localization judgments. In addition, preliminary results of a psychoacoustic experiment designed to measure human localization performance for sources within "arm's reach" of the listener may be presented. [Work supported by AFOSR and NIDCD].

3:45–4:00 Break

4:00

1pPP8. A computational model of the precedence effect based on echo avoidance. Jie Huang (Bio-Mimetic Control Res. Ctr., Inst. Physical and Chemical Res., 3-8-31 Rokuban, Atsuta-ku, Nagoya, 456 Japan), Noboru Ohnishi (Nagoya Univ., Nagoya, 464-01 Japan), Xiaolan Guo (Konan Women's Junior College, Konan, 483 Japan), and Noboru Sugie (Meijo Univ., Nagoya, 468 Japan)

A computational model of the precedence effect is proposed by assuming that the precedence effect is caused by the inhibition of sound localization which depends on the estimated sound-to-echo ratio. It is found that a generalized pattern of impulse response with delay and decay features can be used for echo estimation. As a real neural implementation, the pattern of an after-effect in the human auditory system, based on the previous psychoacoustic just-noticeable-difference tests of interaural delay and intensity, is adopted. This pattern has delay and decay features similar to those in the generalized pattern of impulse response, and the difference in decay scales is shown to cause little difference in echo estimation. The results of psychoacoustic experiments, e.g., equal-level and unequal-level paired click tests [P. M. Zurek, J. Acoust. Soc. Am. **67**, 952–964 (1980); K. Saberi and D. R. Perrott, *ibid.* **87**, 1732–1737 (1990)], Haas's tests [H. Haas, J. Audio Eng. Soc. **20**, 146–159 (1972)], Franssen's tests [J. Blauert, *Spatial Hearing* (MIT, Cambridge, MA, 1983)], and others, can be interpreted consistently. This model can also give criteria for an available onset and an explanation of why a transient onset is required for the precedence effect.

4:15

1pPP9. Anomalous lateralization in the precedence effect with novel two-echo stimuli. Daniel J. Tollin and G. Bruce Henning (Dept. of Exp. Psychol., Univ. of Oxford, South Parks Rd., Oxford OX1 3UD, UK)

The precedence effect refers to the well-known observation that the perceived location of two binaurally presented transient stimuli that are separated by a brief delay depends primarily on the properties of the first arriving sound. In this study, the precedence effect was investigated using 20-μs pulses presented over headphones. Three pulses were presented to each ear simulating a sound coming from directly in front followed by an echo from the side and then from the rear: The first and last binaural pair of pulses were diotic while the middle binaural pair was dichotic with either interaural differences in time or level. A 2AFC lateralization paradigm was used. Highly anomalous lateralization (i.e., lateralization performance near 0%) was observed for many interpulse delays when the total stimulus duration was 2 ms or less. The anomalous results are explained by considering the spectral characteristics of the stimuli.

4:30

1pPP10. Detection thresholds of random amplitude modulation. Edward Ozimek,[a] Jacek Konieczny, Yo-iti Suzuki, and Toshio Sone (Res. Inst. of Elec. Commun., Tohoku Univ., 2-1-1, Katahira, Aoba-ku, Sendai, 980 Japan)

The main objective of this study was to determine the detection thresholds of random amplitude modulation (RAM) as a function of modulation and carrier frequency. Two experiments were performed. Experiment 1 concerned the detection thresholds of AM stimuli for only random amplitude changes at constant modulation frequency. Experiment 2 dealt with detection thresholds for simultaneous, random changes in amplitude and modulation frequency. The data obtained showed that for low modulation frequency, the detection thresholds for sinusoidal amplitude modulation (SAM), random amplitude modulation at constant modulation frequency [RAM(f_m const)], and random amplitude and modulation frequency [RAM(f_s random)] overlapped one another in the limit of SD. However, for higher carriers and modulation frequencies the RAM(f_m const) thresholds were, in a limited range of f_m, much lower than the SAM ones. When random changes in modulation frequency were combined with random changes in amplitude, the RAM(f_m random) thresholds decreased relative to the RAM(f_m const) thresholds. [a]Permanent address: Institute of Acoustics, Adam Mickiewicz University, Poznan ul. Matejki 48/49, Poland.

4:45

1pPP11. Combinations of forward and simultaneous masking, revisited. Walt Jesteadt, Donna L. Neff, and Christina J. Kessler (Boys Town Natl. Res. Hospital, 555 N. 30th St., Omaha, NE 68131)

In previous work, it was found that combinations of a long duration, broadband noise simultaneous masker and a 1000-Hz sinusoidal forward masker can produce as much as 14 dB more masking of a 1000-Hz signal than would be predicted on the basis of a linear power summation of the individual effects of the two maskers. In this study, the effects of masker and signal bandwidth and of simultaneous masker duration on this excess masking were explored. Using a 20-ms sinusoidal signal and a combination of 400-ms broadband-noise simultaneous masker and a 300-ms sinusoidal forward masker, the original effect in a new group of four subjects