Effects of Spectral Content on Distance Perception in Reverberant Space

Norbert Kopco[1,2], Barbara Gail Shinn-Cunningham[1]

[1]Hearing Research Center, Boston University, 677 Beacon St., Boston, MA, United States, [2]Cybernetics and Artificial Intelligence, Technical University, Vysokoskolska 4, c.dv. 151, Kosice, Slovakia

In an anechoic environment, distance perception for nearby sources degrades if there is no low-frequency spectral content in a stimulus, presumably because of the importance of low-frequency interaural level difference cues (Brungart, J. Acoust. Soc. Am. 106:3589-3602). However, distance perception is essentially the same for monaural and binaural stimuli simulated at nearby distances in reverberant space (Shinn-Cunningham, Santarelli, and Kopco, 1999 ARO Abstract #103). These results suggest that low-frequency stimulus content may be less critical for distance perception of nearby sources in reverberant space than in anechoic space. The current study examines the effect of spectral content on distance perception in reverberant space.

Sources were simulated using individually measured head-related-transfer functions taken in a classroom. Sources were simulated at distances from 0.15 to 1.7 m, either directly in front or to the right of the listener. Stimuli were 300-ms-long noise bursts generated by filtering and time windowing white noise. Three broadband (wideband, low-pass, and high-pass) and three narrowband (200-Hz wide stimuli centered at 400, 3000, and 5600 Hz) conditions were tested.

Although inter-subject differences in overall ability were large, the effects of stimulus spectral content were consistent. In general, accuracy was better for broadband than for narrowband stimuli, and better for lateral than for medial sources. In addition, judgments were least accurate for high-pass stimuli.

These results suggest that low-frequency content provides important cues for source distance in reverberant environments, as it does in free-field conditions. However, distance information may be encoded by different stimulus attributes in reverberant and anechoic space.

[Work supported by AFOSR and the National Academy of Sciences]