

ERRATA FOR “PSYCHOPHYSICAL CALIBRATION FOR CONTROLLING THE RANGE OF A VIRTUAL SOUND SOURCE: MULTIDIMENSIONAL COMPLEXITY IN SPATIAL AUDITORY DISPLAY”

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MODIFIED ABSTRACT

Just as control over perceived azimuth and elevation of a virtual sound source should be psychophysically calibrated in spatial auditory display, so should perceived range; however, in contrast to azimuth and elevation display, precise control over auditory range has been difficult to achieve. This is partly due to the multidimensional complexity of the human response to spatial auditory stimulation, but it is also due to the multidimensional complexity of the acoustic stimulus for range, which includes a substantial number of independent parameters even in the case of static spatial positioning of sound sources relative to listener. In the static case, there is strong dependence of auditory range upon at least the following display parameters: direct sound level, indirect sound level, interaural cross-correlation, and the relation between direct and indirect sound spectra associated with air absorption and close-range head-related effects. If the sound source range varies smoothly over time, other display parameters become significant (such as dynamic variation in pitch of the direct sound, or Doppler shift, and also dynamic variation in the initial time gap). These static and dynamic range cues interact to produce changes in auditory range that have proven difficult to successfully model. In the absence of a model that integrates variation in all of these display parameters and successfully predicts range variation, two reasonable solutions to the problem of range control present themselves. The first is to base control upon highly realistic simulation, relying on the relatively good match between perceived range and specified range that can be observed when nearly all displayed auditory spatial information is consistent with an adequate physical model. The second solution is to base control upon psychophysical functions for range derived under conditions of expected use of the display, relying on an inversion of a range prediction model fit to the judgments using multiple regression analysis. This paper presents two examples of successful psychophysical calibration for auditory range control for spatially static sources: One case employed a simplified model of range-dependence in simulated head-related transfer functions for headphone display of virtual sources at close range (within the listener's personal space). The other case employed a room-related (rather than head-related) loudspeaker-based sound simulation to create auditory imagery of sources relatively far away from a group of simultaneous listeners. In both cases, equally loud sources could be displayed with varying auditory range, and adequate range control for a set of sound sources (short speech samples) was achieved using a look-up table derived by inverting the range prediction equation fit to collected human range ratings.

1. ERRATA

1. The German-language term, “Raumeindruck,” should be translated into the English language as “spatial impression” rather than “room impression.” Therefore, the sentence on page 7 of the paper should read:

In the PSFC system, several parameters are adjusted in an inter-dependent fashion in order to maintain an otherwise relatively constant “spatial impression” (in German, “Raumeindruck”), as changes occur in the liveness or “reverberance” (in German, “Halllichkeit”).

2. Both plots in Figure 4 were modified. The left plot was modified to use plotting symbols consistently with previous figures, and the Volume Index values listed in the figure caption were corrected to read “16, 64, and 255” rather than “64, 128, and 255.”
3. There is no item 3. Rather, the reader is referred to the updated version of the paper which contains numerous small changes, including corrected references, etc. That paper has been posted to the Web in both postscript and PDF format at the following site:

<http://www.u-aizu.ac.jp/~wlm/papers/ICAD01>