On the difference between absolute and relative auditory distance perception

Hae-Young KIM, Yōiti SUZUKI, Shouichi TAKANE, Kenji OZAWA, Toshiro SONE
Research Institute of Electrical Communication, Tohoku University
2-1-1 Katahira, Aoba-ku, Sendai, 980-8577 JAPAN

Abstract: In the presence of multiple sound sources, perceptual cues for distance perception may be derived by comparing the sounds from different sources. Thus, two kinds of subjective experiments about the absolute and relative distance perception up to 3 m were conducted. The results of absolute distance perception reconfirmed that the perceived distance of sound image significantly increases with the increase of actual distance of the sound source up to around 1.2 m. On the other hand, the results of the relative auditory distance perception showed that subjects could significantly distinguish two sound sources at 2 and 3 m.

INTRODUCTION

HRTF (Head Related Transfer Function) is an important cue for the absolute auditory distance perception for a single sound source when the sound source is close to the listener (about 1.2 m) [1]. However, cues for general distance perception are still unresolved. Considering that the sound environment in our daily life usually consists of multiple sources, relative distance perception may be more important than absolute distance perception. Therefore, psychoacoustic experiment on relative distance perception with two sound sources as well as absolute one was conducted and the results were then compared and discussed.

EXPERIMENTAL METHODS

Auditory distance perception of an actual sound source was examined by use of a small movable loudspeaker in an anechoic room (7.0×4.6×2.5m). The sound pressure level of stimuli was always kept constant (60 dB SPL) at the listener's position. Thus, any information of loudness and reflection were not provided to subjects. Four male and two female young adults with normal hearing participated in the experiment. Each subject sat on a chair in an anechoic room his/her head fixed on a small headrest. The sound source was a loudspeaker with diameter of 8 cm mounted in a 10×10×20 cm enclosure, of which position was controlled by a computer. Pink noise was radiated from the loudspeaker at either distance of 25, 50, 75, 100, 125, 150, 175, 200, 225, 250, 275, or 300 cm. The source direction was set to one of five azimuthal angles of 0, 45, 90, 135, and 180 degree, where 0 degree corresponds the direction in front of the subject, and 90 degree is to the left hand side of the subject. A curtain was hung between the loudspeaker and the subject for inhibiting the subjects from any visual information about the source distance.

FIGURE 1. Experimental set up of distance perception equipped a small movable loudspeaker in an anechoic room.

(a) ABSOLUTE JUDGEMENT WITH A SINGLE SOUND SOURCE (Exp.1)

The absolute auditory distance perception was examined with single sound source. Moreover, while the loudspeaker was moving, masking noise was radiated from another loudspeaker placed behind the subject for inhibiting the subjects any location information of loudspeaker. As shown in Fig.2 (a), a stimulus was presented twice for one judgement. The number of repetition for an experimental condition was ten.

(b) RELATIVE JUDGEMENT WITH MULTIPLE SOUND SOURCES (Exp.2)

Figure 2 (b) shows the temporal pattern of the stimuli in the experiment for relative distance perception.
RESULTS AND DISCUSSION

The experimental results of the absolute distance judgement (Exp.1) showed very similar tendencies to our previous studies [1,2]. From these results, it is reconfirmed that perceived distance of auditory image increases as the sound source distance goes up to around 1.2 m when any reflections and information on loudness was not given. Moreover, under the condition, the perceived distance hardly increased when the physical distance of the source was over 1.2 m.

In the absolute distance judgment, the perceived distance saturates when the physical distance of the source was over 1.2 m. However, in the relative distance judgment, it was newly found that the difference in perceived distances can be perceived beyond the critical distance and up to 3 m.

The subject’s judgments were then converted into numbers shown in the parenthesis, and the number was regarded as the relative distance between stimuli in the pair. Each part of stimuli was presented two times in random order to each subject. The number of repetition for an experimental condition was four.

CONCLUSION

In the absolute distance judgment, the perceived distance saturates when the physical distance of the sound source is over around 1.2 m. However, in the relative distance judgment, it was newly found that the difference in perceived distances can be perceived beyond the critical distance and up to 3 m at least.

REFERENCES


858