Next-Generation Communication Systems using Sound Localization

Satoshi YAIRI

Associate Professor	yairi@sendai-nct.ac.jp
Affiliated Societies	Acoustical Society of Japan, Virtual Reality Society of Japan
Keywords	Virtual reality (61020), Experimental psychology in general (10040)

Research Topics

・Developing next-generation communication systems using sound localization
・Study of human ability to localize sound sources
・Improving virtual auditory display

Research Seeds

The main purpose of my study is to elucidate human auditory information processing and to develop comfortable communication systems based on human hearing properties. To realize them, interactions among auditory information, visual information, and self-motion perception (Multi Modality) are investigated.

One important tool in my study is the virtual auditory display (VAD). A perceived position of a sound image can be controlled by convolving head-related transfer functions (HRTFs) to the sound source. Systems of this kind are called a "virtual auditory display (VADs)."

To accomplish a high-accuracy VAD system, I investigated the following techniques:
• Presentation of a sound source responsive to the listener's head movement
• Choosing the best set of HRTFs
• Producing sound effects of reflection and reverberation

In VADs responsive to head movement, HRTFs are controlled by detecting the head movement with a position sensor. Therefore, the sound image does not move even if the listener moves. I developed Linux-based VAD software responsive to head movement [1]. The system latency of this system is about 12 ms.

This VAD system has been useful to assess the detection threshold (DT) against head movement [2] and characteristics of a listener's head movement during sound localization tasks [3].

Expressing an accurate three-dimensional sound image is possible using individualized HRTFs. Individualization features of Head-Related Transfer Functions based on subjective evaluation have been investigated [4].

[1] S. Yairi et al., Trans. Virtual Reality Soc. Jpn (in Japanese), 11(3), 437-446, 2006.
[2] S. Yairi et al., Applied Acoustics, 68(8), 851-863, 2007.
[3] S. Yairi et al., Acta Acustica united with Acustica, 94(6), 1016-1023, 2008.
[4] S. Yairi et al., Proc. of ICAD2008, June 24–27, 2008.
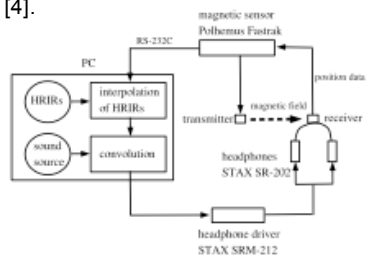
Related Technology

・Linux-based Virtual Auditory Display software responsive to head movement
・Signal processing to realize sound localization using Head-Related Transfer Functions