Bone conducted sound for mixed and virtual reality

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Technology

The BEST (Balanced Electromagnetic Separation Transducer) headset transmits sound directly to the inner ear through the cranium – unaffected by the surroundings.

The BEST headset is capable of inducing a hearing sensation well more than 70 dB above the hearing threshold in the majority of the speech frequency range. Depending on design, the transducer operates from 125 Hz to 10 kHz.

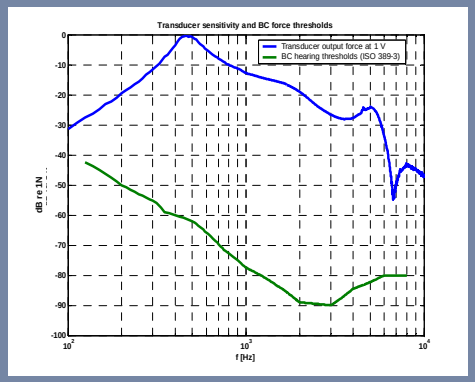
The BEST technology has a number of advantages over conventional Bone Conduction (BC) transducers [4]. Compared to the widely used B71 it yields:

(i) Lower total harmonic distortion ~THD! by 20–25 dB;

(ii) Lower counterweight mass by a factor of 3 for the same resonance frequency;

(iii) Improved sensitivity by 10–20 dB for 100 to 1000 Hz and by 2–10 dB for 1 to 10 kHz; and

(iv) Improved efficiency, in addition to improved sensitivity, since the electrical input impedance is higher by some 1.8 times.



Introduction

Headphones are commonly used to present sound for Virtual Environments and Mixed /Augmented Environments (MR/AR). There are however several drawbacks associated with the use of headphones. Headphones block the ear canal to greater or less extent, which create a heightened awareness of self. In turn, this is believed to decrease presence [1-3]. Furthermore, headphones limit acoustic person-to-person interaction and the possibilities of combining real auditory elements with virtual ones for e.g. MR/AR. In this poster we discuss the possibilities of using a novel sound reproduction technology called BEST (Balanced Electromagnetic Separation Transducer), manufactured by Oiido Equipment [4-5], for VEs and MR/AR. This technology delivers sound via the cranium and keeps the ear canal completely unblocked, which should allow for natural self- and real world awareness and effortless user-user interaction.

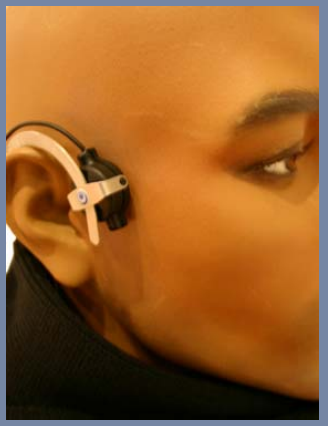
Applications

Oiido's customers often work in noisy and exacting environments. They demand reliable and flexible communications equipment. This makes Oiido their obvious choice. We however suggest that Oiido's BEST technology is also ideally suited for VEs, and AR/MR:

▪Spatial sound reproduction. Recent research has shown that the BEST headset can produce convincing virtual binaural sound experiences and that its performance is comparable to conventional headphone reproduction in this sense.

▪Open ear canals => seamless integration of mediated sound and the real sonic environment, keeps users alert to potentially dangerous situations => Ideal for AR and MR.

▪On-line translation and learning: The spatial separation between real speech and speech reproduced through the BEST headset should facilitate stream segregation and enhance translation and learning applications



[1] Väljamäe, A., Stenfelt, S., Tajadura, A., & Larsson, P. Usage of bone conducted sound in mediated environments. (Manuscript in preparation, 2005).

[2] Pörschmann, C. One's own voice in auditory virtual environments. *Acta Acustica, 87*, 378-388, 2001

[3] Murray, C. D., Arnold, P., & Thornton, B. Presence accompanying induced hearing loss: Implications for immersive virtual environments. *Presence: Teleoperators and Virtual Environments, 9* (2), 137-148, 2000.

[4] Håkansson, B. The balanced electromagnetic separation transducer: A new bone conduction transducer. *Journal of the Acoustical Society of America*., 113, 818-825, 2003.

[5] OIIDO website: http://www.oiido.com