

Further evolution of acoustic devices that do not block the ears

PSZ technology that enables you to hear the necessary sound clearly even in a live concert venue

Tokyo –Nov. 10, 2023 – NTT Corporation (NTT) has established a technology that enables users to hear sound clearly by spatially controlling the sound in their ears even in lively situations such as concert venues where multiple sounds are mixed around the user with an open ear sound device that traps sound only for your ears. This technology is one of the R&D results based on the concept of PSZ (Personalized Sound Zone), which realizes the ultimate sound space in which the sound you want to hear can be heard only by you and sounds you don't want to hear can be suppressed. Part of spatial acoustic application in the entertainment field and in-vehicle ANC technology will be exhibited as use cases in "NTT R&D FORUM 2023 - IOWN ACCELERATION" [1].

1. Background

With the spread of remote work, the use of earphones and headphones for extended periods of time is increasing. Prolonged use of these sound devices has a high burden on the ears, and there are concerns about their impact on health. To solve this problem, NTT has been conducting research and development on acoustic devices such as earphones and headrest speakers that do not block the ears, and has established technology that does not allow the sound of the acoustic device to leak out to the surrounding environment. However, these non-ear-blocking acoustic devices have problems because ambient sound reaches the user's ear. Therefore, NTT has researched and developed a technology that makes it easier to hear sound from sound devices even in an environment where multiple sounds are mixed around the user. In this research, NTT has established two technologies: one is to present sound by using the spatial characteristics of sound from outside, and the other is to reduce sound from outside.

2. Key points of technology

a. Sound source placement technology based on ambient sound conditions

Users of acoustic devices that do not cover the ears can hear the surrounding sound, which presents a challenge because ambient sound covers the sound of the acoustic device, making it difficult to hear the sound. Therefore, we have made it possible to present information by sound even when the user can hear the surrounding sound by controlling the position of the sound of the acoustic device that the user wants to listen to, and presenting the sound, as if the user hears

the sound from a position where the surrounding sound is not covered. In addition, sounds near the user, which are difficult to recreate with distant speakers, are reproduced by an acoustic device near the ear, enhancing the sense of localization. The 180th NTT East NHK Symphony Orchestra Concert Satellite Transmission Performance ^[2] used this technology to improve the intelligibility of the commentary by separating the position of the commentary heard from an acoustic device that does not block the ears from the orchestra's performance.

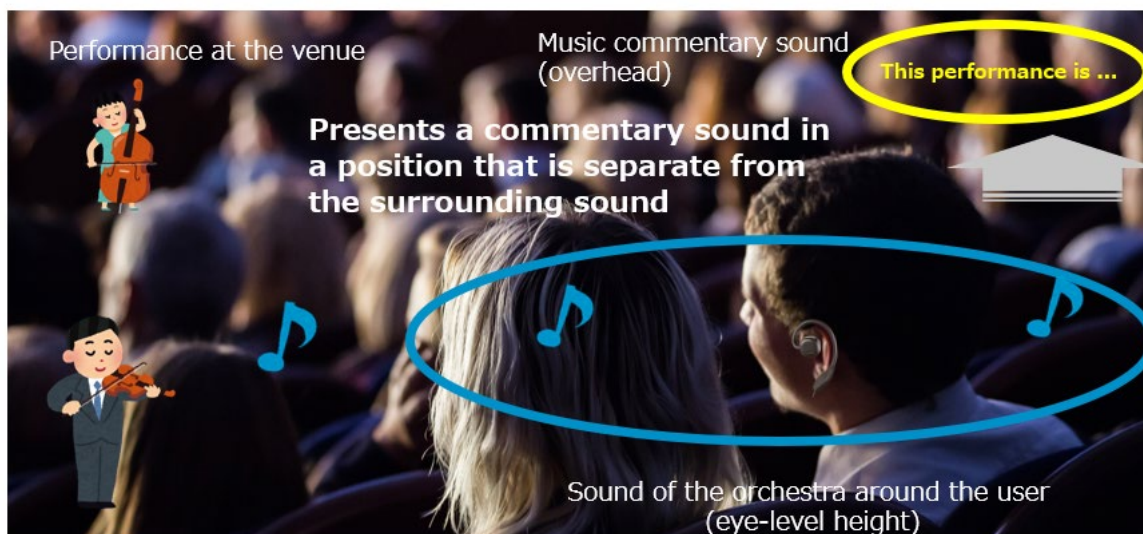
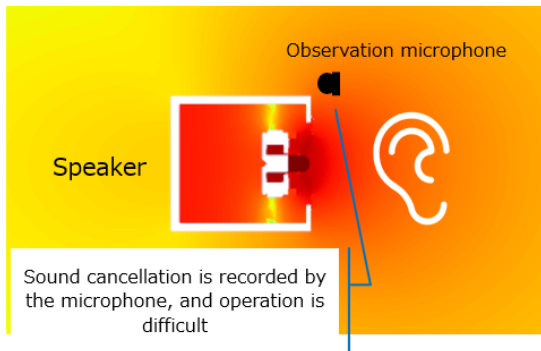


Figure 1 Sound source placement technology that uses the spatial characteristics of ambient sound to add the sound of an acoustic device in the ear for easy listening

b. Active noise control technology (ANC) ^[3] that does not block the ears

To make it easier to hear a sound device without blocking your ears, you need to suppress unwanted sounds around you. To achieve this, it is necessary to cancel unwanted sound waves in the ear by sound waves emitted from speakers away from the ear. However, it was difficult to make it work because the microphones recorded the cancellation sound produced by the speakers away from the ear. In order to expand the area of suppression, conventional speakers have insufficient output. Therefore, NTT developed a new speaker that uses PSZ's spot reproduction technology ^[4] to reduce the amount of sound that is recorded by the microphones, thereby achieving stable operation, and expanding the area of the ANC without blocking the ears.

Traditional speakers away from the ears



New speakers using PSZ spot regeneration technology

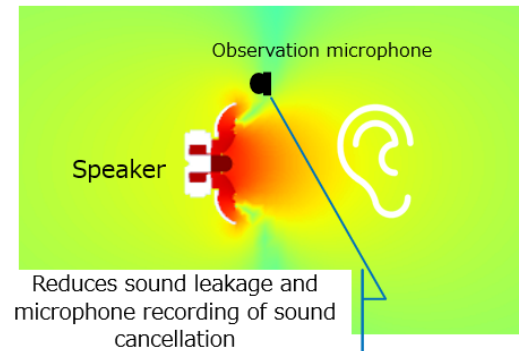


Figure 2 ANC that does not block the ears by new speaker using spot reproducing technology of PSZ

3. Outlook

Using the PSZ technology, we have been conducting field tests such as "Super Kabuki Powered by NTT" ^[5] and the sound production of the XR Extinction Zoo hosted by NTT DOCOMO ^[6]. In the future, based on the results of the verification, we will conduct further demonstration experiments in various fields to improve the feasibility of the technology. We will also work with NTT Group companies to provide services to create new sound experiences.

[1] *Acoustic XR technology, including sound source placement technology based on ambient sound conditions, is planned to be introduced and experienced through demonstration experiments conducted to date. During this period, the NTT Technical Museum will offer audio guide experiences using acoustic XR technology. Using an open-ear acoustic device that utilizes PSZ's spot playback technology, we plan to automatically play guide content from the acoustic device as we approach the exhibit, while ambient sound is also heard naturally. In addition, the ANC technology is linked with the technology to identify the sound that the user needs in order to accurately silence only the sound that the user does not need, and the ANC that does not block the ears and suppresses only the unwanted sound around the user's ear will be shown in the R&D Forum.*

"NTT R&D FORUM 2023 -IOWN ACCELERATION" Official Website

<https://www.rd.ntt/e/forum/2023/>



[2] "The 180th NTT East NHK Symphony Orchestra Concert Satellite Transmission Performance" held on November 2 at Obuse-cho Hokusai Hall - Providing a high sense of presence with high quality sound and a high degree of freedom in the experience of listening to music with multi-angle distribution



<https://www.ntt-east.co.jp/nagano/news/pdf/2012/20230915.pdf>

[3] ANC is a technology to suppress noise by recording ambient noise with a microphone that observes ambient noise and playing back the cancelling sound through the speakers.

*[4] Developed earphone design technology that only the user can hear without blocking the ear
NTT developed a single speaker with sound wave control that delivers sound to the user while counteracting sound leakage to the surroundings*

<https://group.ntt/en/newsrelease/2022/11/09/221109a.html>

[5] Challenge the new spatial sound production of Super Kabuki with "Super Kabuki Powered by NTT"

~ Realize a spatial sound production where the realistic sound of the stage and the sound effects in the ear cross over ~

<https://group.ntt.jp/newsrelease/2023/04/29/230429b.html>

[6] [Event Report] "LOST ANIMAL PLANET XR Extinction Zoo" was held from 2023/10/14 to 15.

<https://www.docomo.ne.jp/corporate/technology/rd/tech/mmwave/20231014/>

About NTT

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