Better speech clarity in
Oticon Own™ SI

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Summary

Own SI, Oticon's new generation of custom invisible-in-canal (IIC) and completely-in-canal (CIC) hearing aids, features an upgraded Deep Neural Network (DNN) for noise suppression and a novel approach to handle loud and soft sudden sounds more precisely. Here, we evaluate the performance of Oticon Own SI 1 compared to its predecessor with single-microphone audiology, Oticon Own 1. The results show that Oticon Own SI 1 CIC provides superior speech clarity to Oticon Own 1 CIC, while maintaining access to speech all around the user.

Introduction

Oticon's new IIC and CIC style hearing aid, Own SI, includes a second-generation always active on-board Deep Neural Network, DNN 2.0, for noise suppression, that builds upon the capabilities of DNN 1.0 in our previous IIC and CIC hearing aid, Oticon Own. Additionally, the SuddenSound Stabilizer (SSS) replaces the Transient Noise Management (TNM) for rapid and balanced processing of sudden sounds. We evaluated these feature advancements and their benefits for the user in a technical benchmark between Oticon Own SI 1 CIC and Oticon Own 1 CIC.

Test setup

We simulated a common speech-in-noise listening environment* and recorded the hearing aid output using a head-and-torso simulator (HATS) in two different setups: Setup 1 with restaurant noise and sudden sounds (Figure 1) and Setup 2 with restaurant noise only (Figure 2). For both setups the HATS was positioned at the center of a loudspeaker array in an acoustically treated sound studio. The following hearing aid settings and test parameters were used:

- Oticon Own SI 1 CIC and Oticon Own 1 CIC with gain programmed for a moderate hearing loss (N3 standard audiogram[2]) using the NAL-NL2 rationale.

- MoreSound Intelligence (MSI) 3.0 and SSS (Own SI) and MSI 1.0 and TNM (Own) set to maximum activation settings.

Signal-to-noise ratio (SNR) enhancement
- An objective measure that estimates how much contrast the hearing aid creates between the foreground speech and the background noise. Increased contrast indicates clearer speech.

- Calculated with the phase-inversion method[1] as the output SNR difference between aided and unaided recordings, the latter serving as the baseline prior to any modification made by the hearing aid.

- Foreground speech: Audiobook excerpts in several languages read by a male talker, played at 65 dB SPL**.

- Background noise: Diffuse restaurant noise played from two loudspeakers at ±112.5°. The noise level was set to 65 dB or 60 dB SPL, corresponding to a complex situation at 0 dB input SNR and a moderately complex situation at 5 dB input SNR, respectively.

- Sudden sounds (Setup 1 only): Sequence of 1s long real-life sudden sounds (e.g., slamming door, dropping coin, footsteps), each separated by 1.5s silence, with a peak-to-peak sound pressure equal to that of a 1-kHz pure-tone at 98 dB SPL***.

- Speech-intelligibility-index (SII)-weighted output SNR enhancement calculated for the right hearing aid.

* Most of a typical user's day is spent in positive SNR environments[3]
** Note that the foreground speech was calibrated with the reference point positioned at 0°. Therefore, the input SNR differed slightly across speech source locations.
*** The input SNRs for Setup 1 are reported for speech vs. noise, excluding sudden sounds.
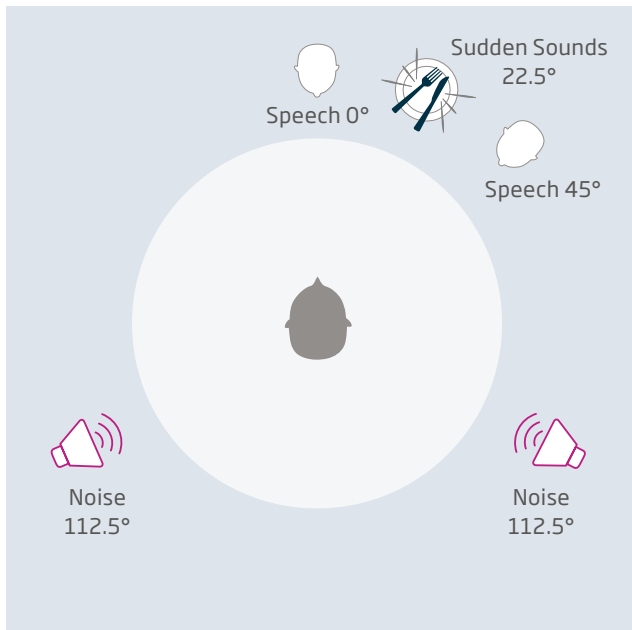
Figure 1: Setup 1 with speech presented from one of the positions shown with a head symbol, noise presented from the two loudspeakers towards the back, and sudden sounds presented slightly to the right.
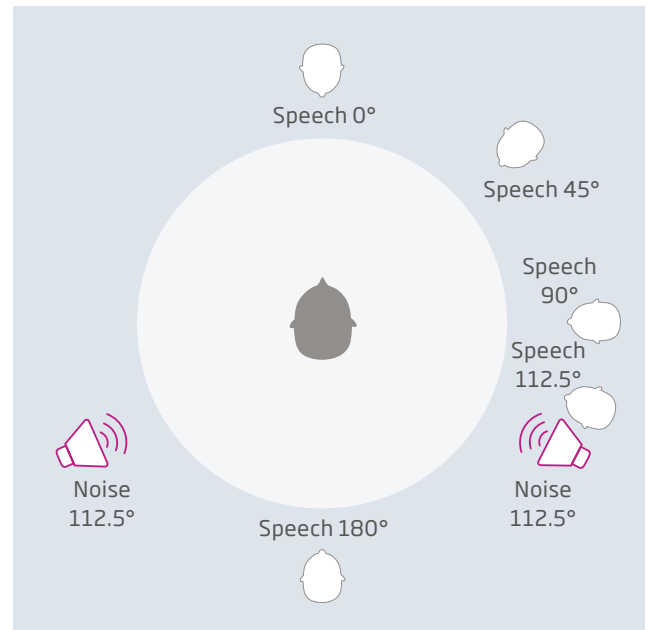

Figure 2: Setup 2 with speech presented from one of the positions shown with a head symbol and noise presented from the two loudspeakers towards the back.

Results: Improved speech clarity

Figure 3 shows the measured output SNR enhancement provided by Oticon Own SI 1 with DNN 2.0 and SSS (dark blue bars) and by Oticon Own 1 with DNN 1.0 and TNM (light brown bars), in complex (left panel) and moderately complex (right panel) situations with sudden sounds (see Setup 1 shown in Figure 1). Oticon Own SI 1 provides up to 5.4 dB SNR enhancement overall in these situations, and consistently better speech clarity than Oticon Own 1, with up to 2.7 dB higher SNR.

DID YOU KNOW?

DNN 2.0[4] is Oticon's second generation of on-board Deep Neural Networks for noise suppression. Trained with more precision on a larger variety of sound samples, it builds upon the knowledge and insights from our first-generation DNN, which was the first-ever chip-embedded DNN in the industry. DNN 2.0 is part of MoreSound Intelligence 3.0 and is always active, whether the sound scene at hand is simple or complex.
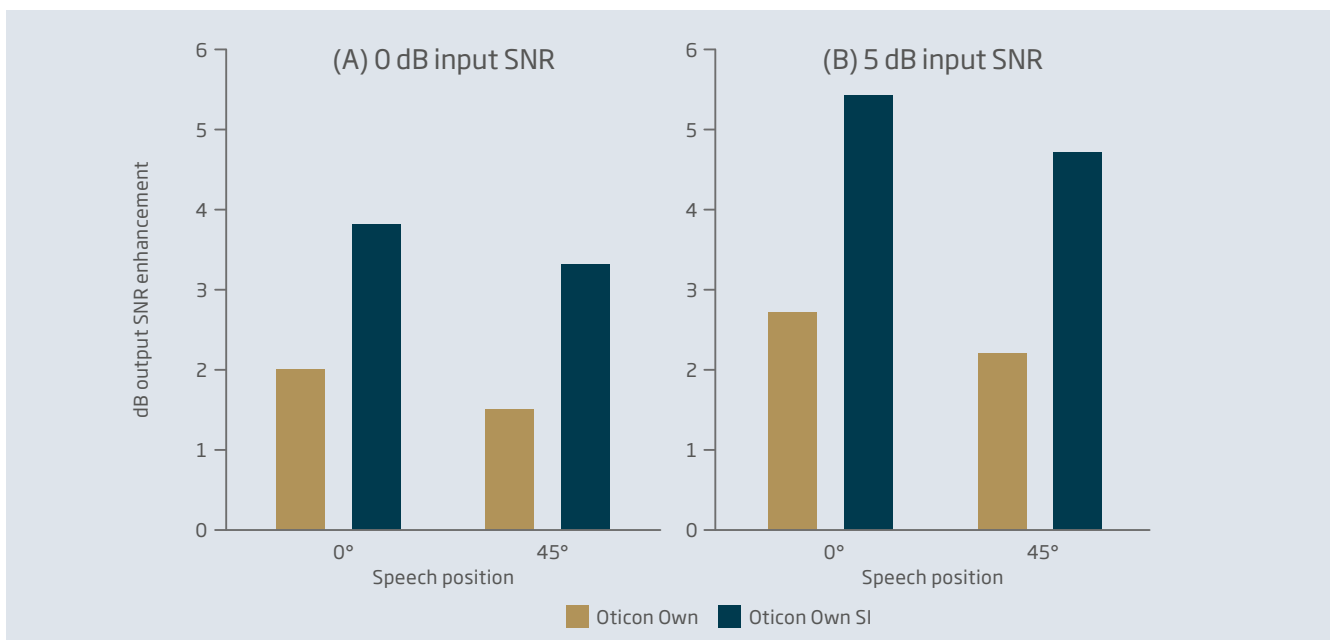

Figure 3: Output SNR enhancement provided by Oticon Own SI 1 CIC with DNN 2.0 and SSS and Oticon Own 1 CIC with DNN 1.0 and TNM, for speech at 0° and 45° presented in restaurant noise with sudden sounds.

Figure 4 shows the measured output SNR enhancement for DNN 2.0 in Oticon Own SI 1 (dark blue bars) and DNN 1.0 in Oticon Own 1 (light brown bars) in the complex (left panel) and moderately complex (right panel) situations for various positions of the speech source (see Setup 2 shown in Figure 2). For all incident directions of the target speech, the upgraded DNN 2.0 in Oticon Own SI 1 provides better speech clarity than DNN 1.0 in Oticon Own 1 in both complex and moderately complex situations, with up to 1.2 dB better SNR enhancement. Better speech clarity is thus ensured by DNN 2.0 independently of where the target speech is located around the user.
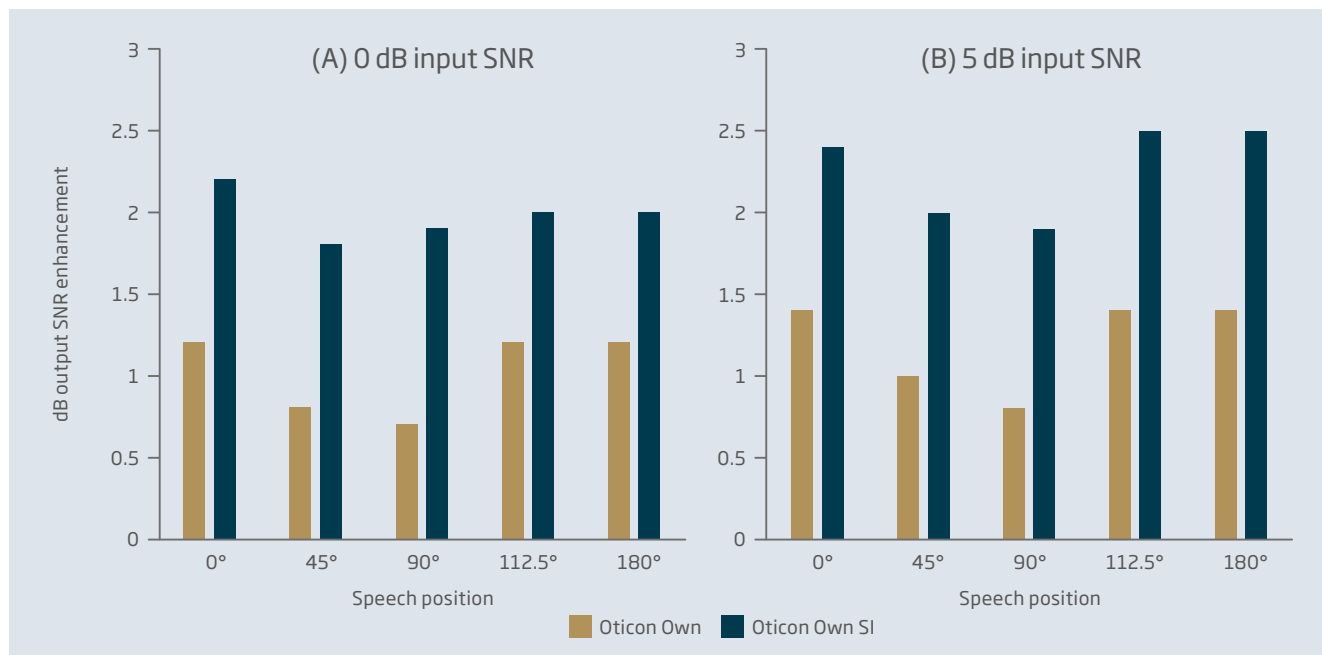

Figure 4: Output SNR enhancement provided by DNN 2.0 in Oticon Own SI 1 CIC and DNN 1.0 in Oticon Own 1 CIC for different speech locations in the horizontal plane.

CONCLUSION

Oticon Own SI 1 sets a new milestone in custom hearing technology, offering better speech clarity than ever before in Oticon's single-microphone hearing aids. With an absolute enhancement of speech clarity of up to 5.4 dB and the always-active on-board DNN 2.0 making speech clearer all around the user, Oticon Own SI 1 offers an improved open sound listening experience and brings advanced BrainHearing™ benefits to users who value a discreet hearing-aid style. By making speech stand out more from background noise than its predecessor by up to 2.7 dB, Own SI better enables IIC & CIC users to follow conversations with ease in everyday listening environments.

Performance of the hearing devices is dependent on individual circumstances and may not be appropriate for all conditions. Always read the label and follow the instructions.

REFERENCES

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