Field Study News

StereoZoom

Improvements with directional microphones

Abstract

With StereoZoom, a new feature available in products of the Phonak Spice Generation, a microphone array, linked by wireless technology, has been developed which not only uses the two microphones on each hearing instrument independently but creates a network of microphones from both instruments in a binaural fitting. This allows new and narrower beam patterns to be created and applied to specific, challenging listening environments. 20 test subjects with a moderate to moderately-severe hearing loss participated in this study to evaluate the benefits of StereoZoom compared to conventional directional microphone systems. Test results showed improved speech intelligibility for Phonak Ambra with StereoZoom compared to Phonak Ambra with UltraZoom and Exélia Art with VoiceZoom. Improved speech intelligibility was demonstrated with the directional microphone system of Phonak Ambra compared to Exélia Art. Furthermore, listening effort has been rated as being very low for all the tested beamformer conditions supporting the known benefits of directional microphones in difficult listening environments.

Introduction

The fundamental idea behind the new StereoZoom system developed by Phonak is the desire to create a directional microphone system which offers additional user benefits in extremely challenging diffuse noise situations, beyond what can be obtained with existing dual microphone systems. To do this requires finding a way to achieve a highly focused directional beam. This is accomplished by creating an array of multiple microphones of binaural hearing instruments linked together via wireless technology. Thus, the dual microphone system on the right instrument is linked to the dual microphone system on the left instrument and vice versa. In practice, this allows for a new beam pattern to be created which is "sharper" than before. The null settings of the beam can now be moved much further to the front, in the range of +/- 45° which produces a very narrow beam and the potential for a more favorable SNR. This means that with StereoZoom, it is now possible to effectively narrow the beam focus to just one individual, with the result that the listener is now able to concentrate fully on a 1:1 conversation in a difficult listening condition. This effect of the very narrow directional beam provided by StereoZoom means it is only appropriate for very specific listening situations where a listener wishes to focus on only one speaker in the presence of competing noise. As a result, StereoZoom is available as an independent program which can be activated by the end user when required, either via the push button on the hearing instrument or by remote control.

The goal of this study was to determine if StereoZoom improves SNR and thereby speech intelligibility in difficult listening situations (Fig. 1).

Test subjects and devices

This study was performed at the Hörzentrum in Oldenburg, Germany. Twenty adult subjects with moderate to moderately-severe hearing loss participated in the study. Test subjects were fitted with Exélia Art and Phonak Ambra microP BTE instruments. All noise reduction signal processing algorithms were switched off and only the directional beamformer and SoundRelax were active during the testing. The following microphone modes were compared to each other: Phonak Ambra microP with UltraZoom, Phonak Ambra microP with StereoZoom, Exélia Art with VoiceZoom and the omnidirectional modes of both instruments. Omnidirectionality of both hearing instruments was selected as a reference measurement to avoid that differences in directional performance would be attributable to systematic differences of the hearing instruments (e.g. different first fit, handling, design, etc.). The different microphone settings were all offered as manual programs in the fitting and microphone settings could be changed by using myPilot remote control. Evaluation of improved speech intelligibility in difficult listening situations with different microphone modes was conducted by adaptively measuring the Speech Reception Threshold (SRT; SNR for 50% speech intelligibility) using the Oldenburg Sentence test (OLSA) in two different Lab setups: Setup 1 - a diffuse scene with continuous speech-shaped noise comprising the adaptive OLSA setup where the SRT of five-item sentences is obtained. Noise presentations were from ±45°, ±90°, ±135° and 180°, with signal presentation from 0°. Setup 2 - a diffuse scene with continuous babble with the following noise presentations: ICRA4 noise from ±60° and 90° as well as babble noise from ±135°

and 180°. Again, signal presentation was from 0°. Speech intelligibility in noise can also result in increased listening effort. To test this relation, a scaling test of listening effort (LE) at different SNRs (-5 to +10 dB SNR) was performed.

Results

With the OLSA, the SNR for 50% speech intelligibility in two different setups was measured after one test trial. Omnidirectionality of both hearing instruments was measured in order to obtain a reference measurement. Results were the same for the two hearing instruments (data not shown). Results of Setup 2 - a diffuse scene with continuous babble and ICRA4 noise from ±60° and 90° as well as babble noise from ±135° and 180°- showed a clear difference between Exélia Art and Phonak Ambra but no difference between Ambra UltraZoom and Ambra StereoZoom (Fig. 2A)). Since the speech signal was presented from the front with noise at ±60°, the wider beam of UltraZoom in Phonak Ambra was still sufficient to reduce the noise, so no difference in speech intelligibility between Ambra UltraZoom and StereoZoom was expected (Fig. 2A).

Fig. 1: Monaural directional microphones have a broad forward focus (gray beam) enabling improved audibility for all sounds within the beam (left side). StereoZoom creates a highly focused beam (green beam) to the front to focus on a single voice in a crowd (right side).

Improved speech intelligibility with Phonak Ambra with StereoZoom was seen in Setup 1 compared to Phonak Ambra with UltraZoom and Exélia Art with VoiceZoom. These results reflect varied performance in a more diffuse noise environment with different noise positions of ±45°, ±90°, ±135° and 180° compared to Setup 2. StereoZoom enables the wearer to narrow the beam further and focus on a single speaker, while suppressing other interfering sounds. Thus, noise from ±45° was suppressed by StereoZoom, while fully amplifying target signals from 0°. The noise on ±45° however still caused interference with the wider beam pattern of VoiceZoom, thereby leading to decreased speech intelligibility scores of Ambra with UltraZoom (Fig. 2B).

Listening effort ratings at different SNRs showed that the different microphone modes, Phonak Ambra with StereoZoom, Phonak Ambra with UltraZoom and Exélia Art with VoiceZoom, yielded similar results, indicating very little strain or listening effort in either a coffeehouse, a nursery, in traffic or a loud cafeteria with babble noise (data not shown). These results further support the known benefits of directional microphones in difficult listening situations (Ricketts and Dhar, 1999; Gnewikow et al., 2005).

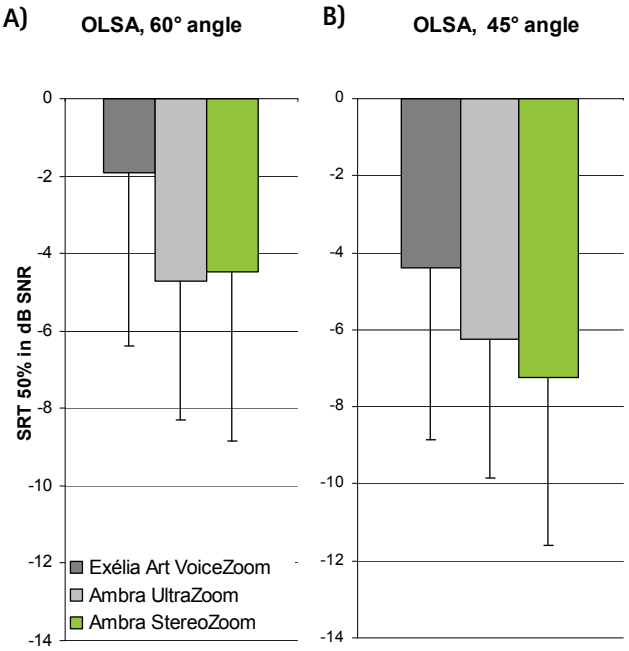

Fig. 2: Speech intelligibility scores in dB SNR of the beamformers of Exélia Art and Phonak Ambra in the OLSA, tested with two different angles to the front (60° and 45°). Results show clear benefits of StereoZoom for a narrower angle of 45° to the front, thereby focusing on a single signal presentation as illustrated in Fig. 1.

Conclusion

With StereoZoom, another significant milestone in the development of beamforming technology has been achieved which exceeds the conventional directional microphone technology available in most hearing instruments. By wirelessly linking the hearing instruments and exchanging full bandwidth audio signals in real time, it is now possible to narrow the focus to one particular individual, reducing interfering noise coming not only from the back and sides but now, for the first time, from near the front as well.

References

Gnewikow et al. 2005. Real-world benefit from directional microphone hearing aids. J Rehabil Res Dev 46(5):603-18

Ricketts T, and Dhar S. 1999. Comparison of performance across three directional hearing aids. J Am Acad Audiol 10(4):180-9

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