

Field Study News

ZoomControl: Part II

Improved localisation and signal detection in noise

Summary

In part I of the study we investigated the benefits of ZoomControl, now also available in Naída IX and Audéo YES, which allows the listener to select different focus directions, thereby enhancing speech intelligibility in noise for listening situations in which the speech signal originates from the back or the sides of the listener. In part II, we discuss the improvements of localization abilities with the aid of ZoomControl. Localization allows us to know the direction of the sound source in three-dimensional space. However, it is not always possible to focus the direction of interest, the direction the sound source is originating from.

ZoomControl, now available both through Phonak's myPilot remote control in Exélia or onboard controls in the new Exélia Art provides significant benefit in difficult listening situations when the signal of choice does not originate from the direction, the hearing instrument (HI) wearer is looking. ZoomControl utilizes the wireless link between binaurally balanced microphones for real-time streaming within the HI. This allows the listener to select different directions of the focus; thereby enhancing speech intelligibility in noise for listening situations in which the speech signal does not originate from the front. 21 experienced adult test subjects with a mild to moderate hearing loss participated in this study where radio broadcasts were presented in a noisy environment. myPilot was used to set ZoomControl in the directions where the speech signal originated from. Results confirmed that the localization of the speech signal with the aid of myPilot highly agreed with the direction of signal presentation. Although not part of the evaluation, myPilot has been rated as very positive and useful.

Introduction

Directional hearing is one part of localization. This activity allows us to know the direction of the sound source in three-dimensional space. Hearing enables us to monitor what's going on in all directions and helps us decide where to direct visual attention (Sekuler and Blake, 1994). Also, our awareness of the position and movement of sound sources is important in providing us with a sense of psychological comfort and security in a listening environment. However, localization and other aspects of spatial hearing are important activities which are limited by hearing loss.

Problems with localization occur even with mild hearing loss (Kramer et al., 1998). The biggest effect of hearing loss on localization is a

lack of audibility. To state the obvious, a sound must be heard before its source can be correctly located.

ZoomControl is designed to allow CORE HI wearers to set the focus of their hearing. To achieve the best focus possible for different listening situations, ZoomControl requires input from all microphones and high-speed wireless communication between the devices offered by the CORE platform. Directional microphones are proven to be the only way to improve Signal to Noise Ratio (SNR), but the benefits of directional microphones are based on the speech source being in front of the end user. Because speech signals do not always come from the front, ZoomControl enables the hearing system wearer to select the focus of the system in four directions: front, back, left, and right. If listening from the side is the chosen direction, due to very fast broadband data transfer function, the microphone signal of the chosen side will be transferred to the opposite, therefore emphasizing the better SNR of the chosen side. The signal is then amplified with the accurate gain model for this ear. However, the microphones of the HI on the "non-focus" side receiving streamed data are attenuated.

The following study was performed at the University of Applied Science in Lübeck, Germany.

Goal of the Study

The goal of this study is to systematically evaluate the benefits of ZoomControl when focusing in the direction of the signal source when the speech signal does not originate from the front.

Set-up of the Study

21 test subjects between the ages of 24 and 86 years participated in the study. All test persons had a mild to moderate hearing loss and were fitted binaurally.

Subjective measures were used. Test subjects were put in a noise environment consistent of an 8 loudspeaker circle, simulating a fully occupied cafeteria with a sum level of 65 dB. While 7 loudspeakers provided the noise, one loudspeaker provided the speech signal. Radio broadcasts with either a female or a male voice as speech signals at 65 dB were presented randomized out of the Loudspeaker from one of the four directions: front, right, back, or left at a distance of 1 m from the test participants. With the aid of myPilot, subjects had to focus

their hearing with ZoomControl in the direction where the speech signal was presented and where speech intelligibility was supposed to be the best. Correct matches of signal presentation and direction of myPilot settings were counted and evaluated. Subjects could choose the following options of myPilot settings: 0°, 90°, 180° and 270° (Fig. 1).

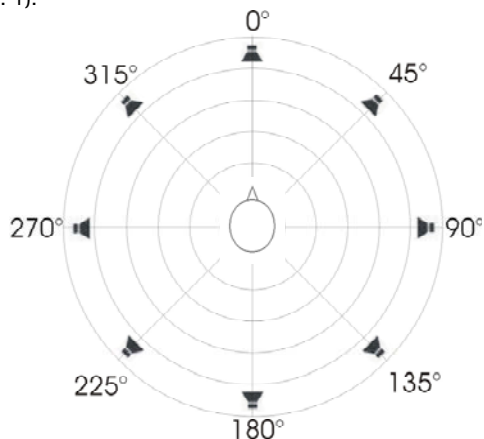


Fig. 1: Test set-up of loudspeaker circle. Seven loudspeakers provided the cafeteria noise at 65 dB, while one loudspeaker presented the female or male speech signal at 0°, 90°, 180° and 270°. Signals and location of signal presentations varied constantly during the test.

Results

The choice of the loudspeaker, signal presentation as well as the two different radio plays and ZoomControl start settings varied constantly. Further, each direction in connection with a speech signal was presented not more than three times. Therefore, test subjects had 24 different signal presentations to localize. Results showed that the chosen direction for signal presentation matched with the real position of the speech signal. Further, it yielded that test subjects had an objective benefit of ZoomControl because of improved speech intelligibility when focusing in the direction of the signal source.

Figure 2 shows the ZoomControl settings of test subjects in relation to the signal presentation for the male voice. It yielded that for 76% the chosen speech signal matched with the ZoomControl directions test subjects chose. The settings of the individual focus chosen with ZoomControl were only confused when the signal was presented from the front. There, test subjects sometimes confused the front with the right or to a lesser degree with the left side when presenting a male voice.

Test subjects then had to correctly define the position of a female speech signal which again was presented randomized from one of the four loudspeakers. It yielded that 79% of ZoomControl settings and signal presentations matched for all of the four signal presentation directions (Fig. 3). Presenting a female voice revealed also difficulties to distinguish front from left side presentation, although not significantly so. Speech signal presentations from the right side and from the back resulted in the best match of ZoomControl settings and effective speech signal presentation.

Functional specialization of the auditory areas of the left and right cerebral cortex has been carefully documented. The general findings indicate that auditory areas of the right hemisphere are specialized for spectral processing of tonal stimuli and music, and areas of the left hemisphere are primary for processing of temporally complex

and rapidly changing stimuli (Zatorre and Belin, 2001). Thus, one could conclude that front/side confusions might be based on the asymmetry of hemispheres. However, since the front/side confusion in this study did not significantly differ with gender, unequal subject positions in the loudspeaker circle during testing might be the reason for localisation difficulties.

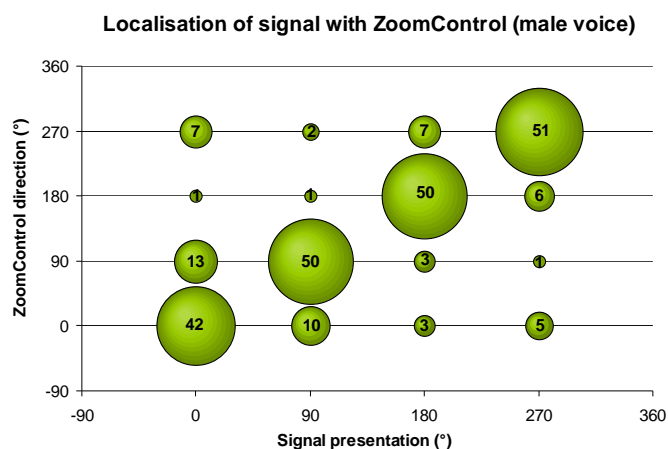


Fig. 2: Correct match of signal and ZoomControl setting when signal was presented of one of the four loudspeakers presenting a male voice.

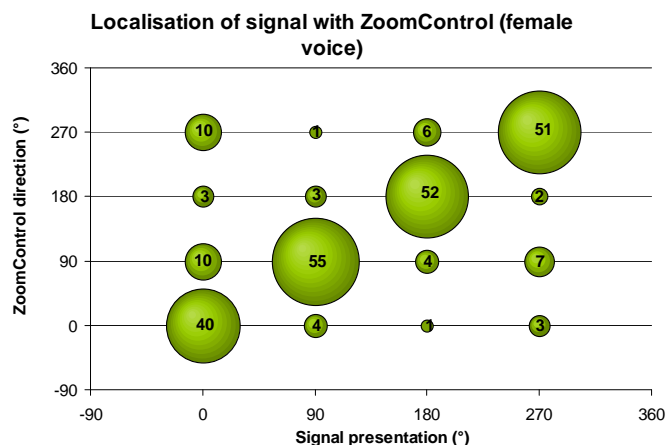


Fig. 3: Correct match of signal and ZoomControl setting when signal was presented of one of the four loudspeakers presenting a female voice.

Conclusion

Directional hearing refers to a listener's ability to infer the direction of a sound source. With ZoomControl subjects are able to individually set the focus of their hearing, therefore providing improved speech intelligibility if the sound source does not originate from the direction in which the end user is looking.

References

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