Benefit of Advanced Directional Microphones for Bilateral Cochlear Implant Users

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The authors have nothing to disclose.
Motivation

• Beamformers and noise reduction technology are being successfully used in hearing aids for more than a decade

• Still, during the last three years, significant advances have been made in the field of signal enhancement:
  – Adaptive beamformers with automatic adaptation to the hearing environment
  – Auditory scene analysis and intelligent sound classification algorithms to automatically switch between parameter settings depending on listening situation
  – Wireless connectivity between two hearing devices to further improve directionality of the microphone

• Many of these algorithms have found their way into the new Naida Q90 sound processor for the Advanced Bionics Cochlear Implant System
Configuration 2: UltraZoom & ClearVoice

- Improvement in SRTs of 4.4 dB with UltraZoom in quasi diffuse noise
- Additional 0.9 dB improvement with ClearVoice
  - 5.3 dB improvement in combination
Noise Management with Naida CI Q90

**Listening situations**

- **360°**
- **Front Focus**
- **Single Front Speaker**
- **Lateral or Rear Speaker**
- **Audio Sources**

**Naida CI Features**

- Omni
- T-Mic
- Auto UltraZoom
- StereoZoom
- ZoomControl Rear Focus
- AudioStreaming
- DuoPhone
- ClearVoice
- SoundRelax
- EchoBlock
- WindBlock

Enhanced speech signal
Noise Management with Naida CI Q90

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enhanced speech signal
Testsetups for *auto UltraZoom*

**in quiet**
- HSM sentences @ 60 dB
- Speech from 0°, +135° and -135°
- *randomized presentation*

**in noise**
- OISa, speech from 0°
- 8-LS Cantine-Noise, 65 dB A

<table>
<thead>
<tr>
<th></th>
<th>T-Mic</th>
<th>UZ</th>
<th>autoUZ → T-Mic</th>
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<tbody>
<tr>
<td>T-Mic</td>
<td>+</td>
<td>-</td>
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Results: *auto UltraZoom* in quiet (n=13)

- for speech in quiet: T-Mic better than UltraZoom → up to 28% better understanding, with speech from the rear

- *auto UltraZoom* recognizes the situation and stays in T-mic-mode
Results: *auto UltraZoom* in noise (n=13)

- for speech in noise: UltraZoom more suitable than T-mic → Up to **5.1 dB** improvement in SRT
- *auto UltraZoom* correctly selects the UltraZoom setting

![Graph showing SRT for different settings](image)

- Target direction
- SRT [dB]
- Better
- **T-Mic**
- **UZ**
- **autoUZ = UZ**

<table>
<thead>
<tr>
<th>Condition</th>
<th>SRT [dB]</th>
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<tbody>
<tr>
<td>T-Mic</td>
<td>-9.5</td>
</tr>
<tr>
<td>UZ</td>
<td>-10.0</td>
</tr>
<tr>
<td>autoUZ = UZ</td>
<td>-4.9</td>
</tr>
</tbody>
</table>
Results: *auto UltraZoom* in noise (n=13)

For speech in noise:
UltraZoom more suitable than T-mic
→ Up to 5.1 dB improvement in SRT

*auto UltraZoom* correctly selects the UltraZoom setting

In both listening situations (quiet and noise) *auto UltraZoom* selects the most suitable microphone setting!
**StereoZoom**: Binaural Adaptive Beamformer
StereoZoom in noise (n=13)

- OISa, speech from 0°
- 7-LS OL-Noise, 65 dB A

→ StereoZoom yields an additional benefit of Ø 1.5 dB
Summary

• Speech intelligibility measurements were done in different challenging acoustic setups

• *auto UltraZoom* selects the most suitable microphone setting for conversations in noisy (UltraZoom) and quiet (T-Mic) listening situations

• Large significant improvement of hearing performance in noise when using UltraZoom and *StereoZoom*:
  • Up to 6 dB for UltraZoom combined with ClearVoice depending on the test scenario
  • An additional benefit of 1.5 dB for *StereoZoom* compared to UltraZoom