Intelligent Hearing Aid Project
Beckman Institute
University of Illinois at Urbana-Champaign
Douglas Jones

Goal:
Develop high performance auditory processors which can effectively extract a desired speech signal in the presence of multiple competing sounds.
**Intelligent Hearing Aid Project**

**Date:** 24 Aug 1999

**Performing Organization:** Beckman Institute

**Sponsoring/Monitoring Agency:** DARPA, Air-Coupled Acoustic Microsensors Workshop held on August 24 and 25, 1999 in Crystal City, VA., The original document contains color images.

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- Report: unclassified
- Abstract: unclassified
- This Page: unclassified

**Limitation of Abstract:** UU

**Number of Pages:** 7

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Algorithm 1: Localization and Cancellation

- Separation by Frequency
- Dual Delay Lines
- Identify Source Locations
- Cancel Noise by Steering Nulls
Algorithm 1: Localization and Cancellation

Localization in the Brain

Localization by Computer
(measure of coincidence vs. azimuth)

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Algorithm 2: Minimum Variance Cancellation

- Separation by Frequency
- Minimize Off-Axis Signal Strength
## Experimental Examples

The old train was powered by steam

<table>
<thead>
<tr>
<th>Target @ 0°</th>
<th>Interferor @ 65°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twelve talker babble</td>
<td>Target @ 0°</td>
</tr>
<tr>
<td>Interferor @ 30°</td>
<td>Interferor @ 22°</td>
</tr>
<tr>
<td>Combined Waveform</td>
<td>Combined Waveform</td>
</tr>
<tr>
<td>Reconstructed Waveform</td>
<td>Reconstructed Waveform</td>
</tr>
</tbody>
</table>

Stir your coffee with a spoon. Stir your

He killed the dragon with his sword.

His plan meant taking a big risk. His pl

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# Experimental Summary

(ALGORITHM 2)

<table>
<thead>
<tr>
<th>Expmt #</th>
<th>Position Attenuation</th>
<th>Position Attenuation</th>
<th>Position Attenuation</th>
<th>Position Attenuation</th>
<th>Average Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-75° 4.8 dB</td>
<td>Target: 0° 0.6 dB</td>
<td>20° 4.1 dB</td>
<td>75° 2.1 dB</td>
<td>6.2 dB</td>
</tr>
<tr>
<td>2</td>
<td>30° 6.3 dB</td>
<td>-45° 4.2 dB</td>
<td>60° 3.1 dB</td>
<td>Target: -10° 0.6 dB</td>
<td>6.7 dB</td>
</tr>
<tr>
<td>3</td>
<td>Target: 10° 1.1 dB</td>
<td>-80° 3.9 dB</td>
<td>-50° 2.9 dB</td>
<td>45° 2.7 dB</td>
<td>4.6 dB</td>
</tr>
<tr>
<td>4</td>
<td>-30° 6.3 dB</td>
<td>15° 0.9 dB</td>
<td>Target: 5° 0.9 dB</td>
<td>-60° 3.6 dB</td>
<td>5.3 dB</td>
</tr>
<tr>
<td>5</td>
<td>-25° 5.7 dB</td>
<td>Target: 25° 0.7 dB</td>
<td>-70° 4.3 dB</td>
<td>80° 2.9 dB</td>
<td>6.3 dB</td>
</tr>
</tbody>
</table>

Recordings made in a Conference Room
Current and Future Work

• Real-Time Implementation
• Microphone Compensation
• Dereverberation

Thanks to Dr. Chen Liu (now at Motorola), Dr. Marc Goeygou (now at U. Lisle) and grad students Mike Lockwood and Mark Elledge