Why Wearable Microphones?

- Microphones are proliferating in mobile and wearable devices. These mics could be combined into powerful arrays.
- This new data set will help to answer questions about wearable array design:
  - What are the benefits of wearable arrays for listening applications?
  - How many mics should be used and where should they be placed?

Open data set of over 8000 impulse responses

Download: go.illinois.edu/wearablemics
Learn more: go.illinois.edu/augmentedlistening

Effects of Clothing

A wearable array would work under light clothing but not heavy outerwear.

Average attenuation with clothing compared to uncovered microphones for sources on the same side of the body

Data Collection

<table>
<thead>
<tr>
<th>Subjects</th>
<th>1 human &amp; 1 mannequin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Acoustically treated lab</td>
</tr>
<tr>
<td>Source spacing</td>
<td>15° (24 directions)</td>
</tr>
<tr>
<td>Test signal</td>
<td>30 sec linear sweeps</td>
</tr>
<tr>
<td>Sampling</td>
<td>24 bits at 48 kHz</td>
</tr>
<tr>
<td>Microphones</td>
<td>Omnidirectional lavaliers</td>
</tr>
<tr>
<td>Loudspeakers</td>
<td>3.5&quot; studio monitors</td>
</tr>
<tr>
<td>Data format</td>
<td>Wave and Matlab</td>
</tr>
</tbody>
</table>

Performance: Array Size

Large wearable microphone arrays perform better than conventional earpieces.

Average beamforming gain for an MVDR beamformer with 6 randomly selected speech sources

Human and Mannequin

A plastic mannequin is a reasonable acoustic analogue for a live human.

Average attenuation from sources on one side of the body to microphones on the opposite side of the body

Wearable Accessories

- Earpieces
- Headphones
- Baseball cap
- T-shirt
- Dress shirt
- Sweatshirt
- Hard hat
- Brimmed hat (40 cm diameter)
- Brimmed hat (60 cm diameter)

Clothing and Outerwear

- T-shirt
- Dress shirt
- Sweatshirt
- Pullover
- Wool coat
- Leather jacket
- Baseball cap
- Brimmed hat (40 cm)
- Brimmed hat (60 cm)
- Hard hat

Performance: Mic Placement

Arrays spread across the body perform better than small wearable accessories.

Average MVDR beamforming gain with 6 speech sources for arrays with different combinations of 18 microphones

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