ILLINOIS
Coordinated Science Lab
COLLEGE OF ENGINEERING

Acoustic Impulse Responses for Wearable Audio Devices

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AUDIO AT ILLINOIS

Motivation

- 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?

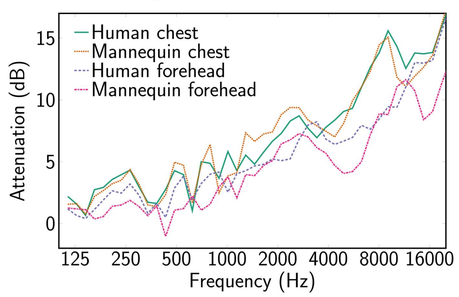
How many mics should be used and where should they be placed?

Data Collection

Subjects	1 human & 1 mannequin
Environment	Acoustically treated lab
Source spacing	15° (24 directions)
Test signal	30 sec linear sweeps
Sampling	24 bits at 48 kHz
Microphones	Omnidirectional lavaliers
Loudspeakers	3.5” studio monitors
Data format	Wave and Matlab

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

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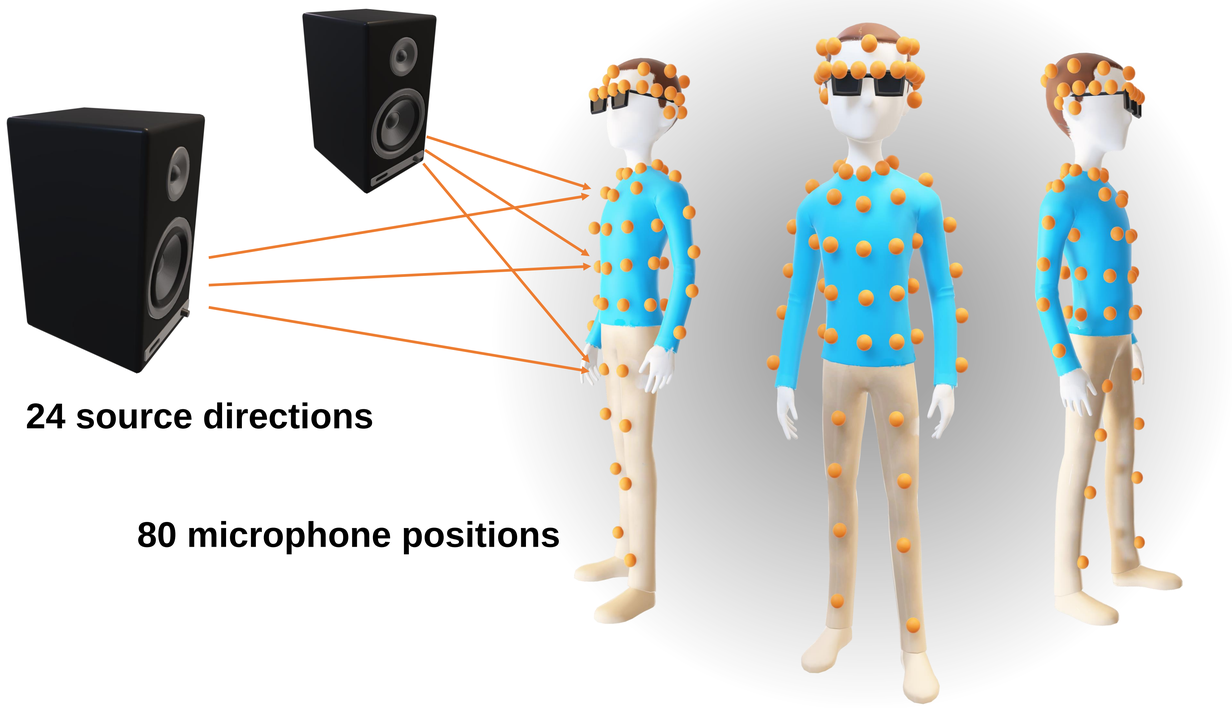
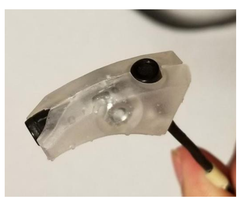
Open data set of over 8000 impulse responses

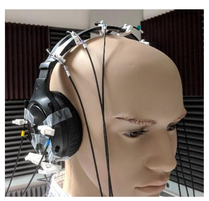
Download: go.illinois.edu/wearablemics

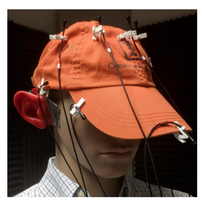
Learn more: go.illinois.edu/augmentedlistening



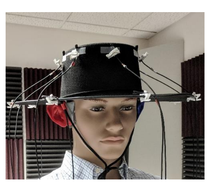
Wearable Accessories

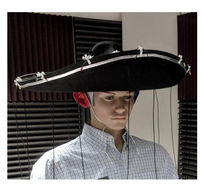

Earpieces


Headphones


Baseball cap


Hard hat


Brimmed hat (40 cm diameter)

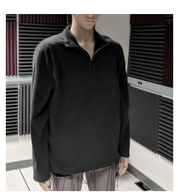

Brimmed hat (60 cm diameter)

Clothing and Outerwear

T-shirt


Dress shirt

Sweatshirt

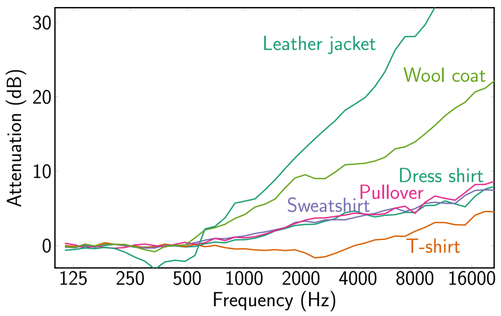

Pullover


Wool coat


Leather jacket

Effects of Clothing

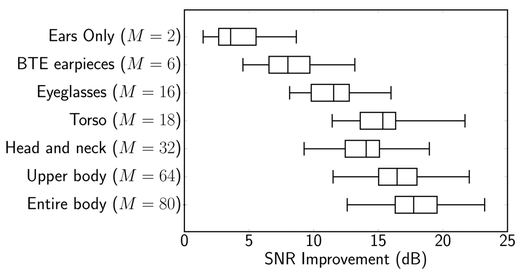
A wearable array would work under light clothing but not heavy outerwear.



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

Performance: Array Size

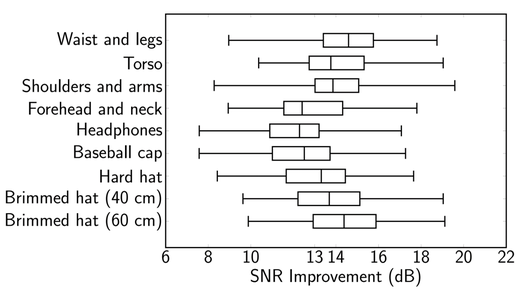
Large wearable microphone arrays perform better than conventional earpieces.



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

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