



# Augmented non-invasive hearing system

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## Augmented Non-invasive Hearing System

This technology is a noninvasive hearing multiplexing device that uses ultrasound signals to transmit audible sounds by exploiting cochlear regions that are under-utilized. The device, which is attached to the head/neck region, sends modulated ultrasonic signals to vibrate brain fluids. This vibration, in turn, produces audible sound signals in channels that are typically not used. As the signals are sent as vibrations through brain fluid, the airborne sound coming through the ear canal remains undisturbed. In other words, the device can be used to perform multiplexing with the cochlea to send desired sound signals in new perceptual channels without affecting normal hearing.

## Multiplexed Hearing Without Masking

Humans can hear sound signals in frequency ranging from 20Hz to 20kHz. However, some frequencies in this range are attenuated by the outer/middle ear (e.g., below 100Hz and above 8kHz). The technology described here uses modulated ultrasonic signals to enable hearing in those under-used frequencies. Multiple transmitters can be used to simultaneously stimulate different regions of the cochlea without distorting airborne sound. Such a technology can be utilized to send speech or other useful sound signals in a noisy environment, such as construction sites, war zone, or manufacturing facilities. This technology can be integrated with cell phones and other consumer products. This technology may also be used to develop new types of music production that combines normal sound along with ultrasound hearing. The device and accompanying algorithm can be optimized based on individual's hearing preference and anatomy.

## Phase of Development

Preliminary proof of concept in animal studies

## Benefits

- Non-invasive; no earplugs or implants
- Multiplexing without distortion and masking
- Retains normal hearing
- Bypasses damage-prone regions of ear
- Comfortable design

# Features

- Specifically and locally activate under-used portions of the cochlea
- Does not vibrate the entire skull
- Multiple channels targeting different regions of cochlea
- Can be placed anywhere on the head - an ear-free sound delivery system
- Optimizable based on individual's preference and anatomy
- Can be integrated into hearing aids, cell phones, consumer products, entertainment devices, etc.

# Applications

- Can be used for transmitting speech signal in noisy environments such as warzone
- Novel entertainment applications with new sounds
- Facilitates silent communication
- Military, clinical, and consumer applications

## Researchers

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