# Ultrasound-based Hearing Aid

**IP Status:** Issued US Patent; **Application #:** 15/581,714

### Ultrasound stimulates cochlear fluid vibrations, induces hearing in brain

A novel ultrasound hearing aid noninvasively restores hearing by activating the auditory system of the brain. The technology uses ultrasound stimulation to create waves and vibrations in the brain fluids. These waves and vibrations vibrate cochlear fluids through the inner ear canal, which activates the auditory brain and induces hearing. The ultrasound can also vibrate cochlear fluids directly to induce hearing. The method bypasses all potentially damaged pathways (e.g., ear canal, eardrum, middle ear bones/ossicles, stapes-round window interface and/or cochlear malformations). The device uses modulated and burst patterns with low intensities (typically within the 100kHz to 1MHz range) so it is feasible for daily use. The device would be designed with unique configurations of ultrasound transducers placed on the head or even in different neck/body regions. The number and location of the transducers would be optimized for each patient during fitting. A behind-the-ear or body-worn device/processor with a microphone picks up sound signals and extracts them to the transducers.

### Significant advantages over conventional hearing aids

The ultrasound hearing aid features four major advantages over conventional hearing aids:

- **No "acoustic" feedback.** Because ultrasound cannot normally be heard, feedback heard in traditional hearing aids is no longer an issue.
- **Restores hearing for a much wider range of etiologies**. Current methods attempt to activate only the hearing pathway from the eardrum to the cochlea and may employ a variety of hearing aid devices (e.g., acoustic hearing aids, bone-anchored hearing aids, middle ear implants and recent laser-based hearing aids). The ultrasound hearing aid, which bypasses these parts and uses a direct pathway to the natural fluid vibration mechanism of the cochlea, may replace most types of existing hearing aid devices.
- **Less "noise."** Traditional hearing aids amplify certain frequency bands (those for which the patient has lost hearing) so they can pass through the damaged pathway from the eardrum to the cochlea. However, amplifying sounds in one frequency band inevitably activates other frequency regions of the cochlea and hearing system. Since the ultrasound hearing aid bypasses the damaged portion from the eardrum to the cochlea, it does not require amplification to a specific frequency band. Instead, it recreates incoming sound naturally, directly into the cochlear fluids, by modulating the ultrasound carrier matched to the incoming sound.
- **"Ear-free hearing;" no component inserted into ear canal.** Traditional hearing aids require a small speaker or sound tube to be inserted into the ear canal, which can occlude the ear or become an uncomfortable. The ultrasound stimuli can be transmitted through a device placed on the head outside or behind the ear, rendering it an "ear-free" hearing system.

### Phase of Development

- In Vivo/animal studies

### Technology ID

20160345

### Category

Life Sciences/Human Health
Life Sciences/Medical Devices

### Learn more

## Benefits

- Restores hearing non-invasively
- Feasible for daily use
- No "acoustic" feedback issues
- No need to insert speaker or sound tube into ear canal

## Features

- For nearly all patients with hearing loss (with sufficiently intact cochlear hair cells and auditory nerve fibers)
- May replace all/most current types of hearing aid devices
- Recreates more natural vibrations in the cochlea with less "noise"
- Activates auditory system of the brain using ultrasound stimulation
- Number and location of transducers optimized for each patient
- Bypasses potentially damaged hearing pathways

## Applications

- Hearing aids/hearing loss
- Treating tinnitus
- Consumer music, phone or other audio applications

**Researchers**


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**Publications**


*Ultrasound Produces Extensive Brain Activation via a Cochlear Pathway*
*Neuron*, VOLUME 98, ISSUE 5, P1020-1030.E4, JUNE 06, 2018


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