

MEETING NOTES: *Machine Learning & Artificial Intelligence in Hearing Devices*

At our Nov.13, 2021 meeting, our guest speaker for a second time was Dr. Shariq Mobin, Ph.D., graduating from the University of California, Berkeley, with a doctorate In auditory neuroscience and machine learning. During the last few years, Dr. Mobin has been researching algorithms that amplify specific voices in noisy places where it's often difficult to hear what people are saying. Dr. Mobin is the founder and CEO of AudioFocus, Inc., a start-up developing new hearing aid technology by using machine learning and artificial intelligence to help people hear speech better in noisy environments. Initially, Dr. Mobin set out the goal of his presentation today: "To help you understand what are these new features that are coming out in hearing aids (H/A's), and are they going to be able to improve your quality of life." He then laid out his agenda as follows: Problems Hearing Aids (H/A's) Don't Solve; Speech in Noise; How The Brain Solves These Problems; Engineering Tools to Solve These Problems; Case Studies & Polling Exercise; Overview of AudioFocus.



Shariq Mobin, Ph.D.
Founder of
AudioFocus, Inc.

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Problems Hearing Aids (H/A's) Don't Solve

During his prior presentation two years ago, Dr. Mobin described how Bluetooth technology applications are used as a means for our devices to communicate wirelessly and how they have proved to be quite helpful to those with a hearing loss. Bluetooth allows you to edit how your H/A's are functioning by adjusting the settings or the volume of your H/A's with a more fine-grained control, based on commands on your phone or other devices.

Nevertheless, there remain some problems with H/A's that have been particularly difficult to solve. One of these problems is the difficulty that many persons with hearing loss experience—that of hearing and understanding speech in noisy environments, such as a meeting or restaurant. As an example, Dr. Mobin showed a brief excerpt from the video "*Let's Make It Clear*" of a problem that a woman with a hearing loss had in hearing and responding appropriately to a waiter's questions in a busy restaurant with lots of background noise.

Relying on several colorful visual representations, Dr. Mobin went on to demonstrate how the process of hearing sound works as follows:

- The sound enters your ear;
- The sound vibrates your eardrum;
- The vibration excites your cochlea inside your inner ear;
- The cochlea does a high vs. low frequency analysis of the sound;
- It then sends the sound signal to your brain to interpret what is being said.

Speech in Noise

Dr. Mobin then reminded us that our hearing loss often results in a blurring, distorting effect on the sharp edges of sound. This is also described as the "Speech in Noise" problem where the background noise interacts with the voice you're trying to hear and understand, whereby the noise interrupts your ability to perceive the words clearly.

The key points are: 1) Hearing loss distorts sound; 2) Background noise typically magnifies the sound distortion and especially hinders the hearing and understanding of speech.

Hence, individuals with hearing loss are often confronted with difficulty of hearing adequately in noisy environments, such as restaurants, cafes, parties, musical events, meetings, television and

driving in cars or trucks. Even when wearing hearing aids, individuals may find it hard to hear other people's speech and be able to clearly detect and understand what others are saying when there is a lot of concurrent background noise.

How The Brain Solves These Problems

Dr. Mobin proceeded to explain how the massive number of neurons in one's brain makes it possible for the brain to determine the direction from which sound and speech are coming. For example, when sound is heard in your left ear and right ear at the same time, then your brain is able to detect that the sound is coming from in front of you. When sound from one side reaches your left ear before your right ear, your brain is able to detect that the sound is coming from the left side.

The key points are: 1) Our brains use timing and loudness level from our left and right ears to localize and enhance sound; 2) Both Inter-aural Timing Differences (ITD) and Inter-aural Loudness Level Differences (ILD) are important in determining the direction of specific sounds and in helping to decipher speech, even in noisy environments.

Engineering Tools to Solve These Problems

Artificial Intelligence (AI): Over the years, engineers have developed tools based on artificial intelligence to help solve the problems that people with hearing loss experience. Artificial intelligence is the general term describing any machine that mimics human brain intelligence and behavior. Here are some examples of how engineers have used AI:

Signal Processing Tools: These are the traditional type of tools that engineers have used in producing hearing devices during the last 20+ years, and they generally work fine for those with normal hearing and processing. Although these tools are sometimes marketed as directional microphones or speech enhancement of the voice in front of you, these features do not typically work anywhere near as well as your brain does.

Machine Learning (ML): Based on artificial intelligence, a machine or device can be trained to learn and function in a specific way automatically from lots of data examples. For example, a machine can learn to distinguish by color or size whether an image is either an apple or orange by having it go through a thousand or more iterations, thereby learning to estimate and identify automatically the distinctions between an apple and orange. For some time, engineers have been working on designing an algorithm (defined as a mathematical rule or procedure for solving a problem) that can be used to teach H/A's to be able to separate speech and noise.

Deep Learning (DL): This is a new type of machine learning also based on artificial intelligence that uses a deep neural network (DNN) inspired by the human brain. Relying on deep learning, devices such as H/A's are being designed to use inputs, hidden layers and outputs to learn how to automatically carry out specific tasks, such as separating apples from oranges, or speech vs. noise on H/A's.

Case Studies & Polling Exercise

As a fun exercise, Dr. Mobin presented a few video case studies that included marketing advertisements for hearing aids sponsored by *Starkey–Livio Edge 2.0*; *Widex Sound Sense Learn*; *Oticon More*; and *Whisper*. Dr. Mobin also described some features based on machine learning that are often included in the newer H/A's, such as: H/A Tuner; Speech Enhancement; and Direction Speech Enhancement. After watching each of the brief marketing ads, audience members were polled regarding which features were being offered in each of the company's brand of H/A's, before the correct answers were shared. The exercise was intended to help audience members to better understand how machine learning and artificial intelligence are currently being used to improve hearing aids.

Overview of AudioFocus:

Acknowledging that hearing aids can help most persons to hear better in quiet places, Dr. Mobin explained that his prior research at UC Berkeley and his on-going research at AudioFocus has been focusing on solving the major problem of speech detection in noisy backgrounds. For example, a noisy restaurant is an environment where there might be 10-100 voices, but you may only want to pay attention to the voices of 3-4 friends or family members.

Hence, at his company AudioFocus, Dr. Mobin is trying to solve such speech in noise problems by using machine learning to design algorithms for hearing aids that selectively amplify only the sounds important to you and build a custom model or “voice print” for specific people, such as family, friends, or work colleagues. Then, if you are in a noisy place and attempting to talk to these specific people, you can rely on the voice prints of those people to selectively amplify only those voices so you can hear those voices, but not all the background noise. Dr. Mobin admits that solving the problem of hearing and detecting speech in noisy places is quite a challenge. Nevertheless, based on machine learning and artificial intelligence, Dr. Mobin is continuing his research and development of a prototype for hearing aids that will automatically transform speech in noise to clear speech.

For More Information or Questions: For more information about the current research at AudioFocus, please visit <https://www.audiofocus.io/demo>. If you are interested in signing up as a volunteer for trying out and helping to improve their early prototype, please email Dr. Shariq Mobin at shariq@audiofocus.io or call (510) 650-6724.

~ Kathy Fairbanks



Tech Talk

By (Ms.) Dale Davis
December, 2021



We would like to introduce a new column in our Monthly Newsletter to cover snippets from the world of technical advancements in the hearing assistance industry. If you have topics you would enjoy seeing covered, or suggestions for news articles, please let us know. This column will also try to answer any technological questions you might pose.

Please Note:

These products and innovations are brought to you for informational purposes only and do not reflect any endorsement by the National Hearing Loss Association of America or the East Bay Chapter. You can follow the links in the column for more in-depth information on the topics presented.

Not So Fast! Clarifications on Last Month's Feature:

Contributed by Ann Thomas, President, Hearing Loss Association of America, Diablo Valley Chapter

How LE Audio Will (Some Day!) Revolutionize the Way You Hear the World

Last month's column trumpeted a completely new audio architecture that promises many benefits to people with hearing loss. However, the time frame for the introduction of this next generation of Bluetooth audio was overly optimistic!

Ann has pointed out that the specs for BT LE (Blue Tooth Low Energy) technology have not yet been adopted by the major players in this field. **Realistically, we are looking at least 10 years down the road for this technology to be widely available.**

The danger here, Ann explains, is that organizations and agencies might forego **proven** technologies that assist the Hard of Hearing while waiting on something promised in the far future. Much of the work of the *Hearing Loss Association of America* is devoted to advocacy and encouraging compliance with the ADA. It's important that we don't give places of public accommodation an "out" for not installing T-Coil loops and providing other ALDs (Assistive Listening Devices) that would benefit people with hearing loss now. Though we can see many promising technologies down the road, the hard work of providing for our needs must be done with the widely recognized technology that we have now.

Ann Thomas is a dynamic and award-winning hearing loss advocate. She is president of Hearing Loss Association of America-Diablo Valley Chapter, a member of the HLAA Get in the Hearing Loop Committee, and an HLAA trained Hearing Assistive Technology Specialist.

As with all hearing health device decisions, it is always best to consult with a professional Audiologist to find the best solution for your needs.

To contribute to this column, please contact: info@hearinglosseb.org

IHAC - International Hearing Access Committee



Hearing Loops and Telecoils: When Will They Become Obsolete?

The International Hearing Access Committee (IHAC) aims to estimate the time a transition from the existing audio transmission to telecoils via hearing loop (HL) and other assistive listening systems (ALS) to a platform of digital audio streaming direct into hearing aids, will likely take.

Telecoils (TC) are small copper wire coils integrated in most hearing aids (HA), HA accessories and cochlear implants (CI) in use today. The TC is designed to pick up electromagnetic analog signals from telephones and from HL/ALS which are designed to improve communication access for people with hearing loss¹ in venues where distance, reverberation and background noise prevent comprehension.

Telecoils have important advantages for hearing aid and cochlear implant users such as:

- **Ease of use by people of all ages.**
- Availability in nearly all hearing devices.
- Affordability (no cost to users beyond the price of the hearing aid).
- **Energy efficiency (little or no battery drain).**
- Universality, any TC can connect to any ALS. No matter their brand of HA or brand of ALS.
- Very low latency, which is important in real-time events.

However, TCs have only 1 channel (no stereo), and are sensitive to electromagnetic interferences.

IHAC recognizes that since 2014 the European Hearing Instrument Manufacturers Association (EHIMA) has **taken serious steps to get a hearing aid profile (HAP) as a standard for Bluetooth connectivity.**² This will ultimately permit direct streaming of high-quality stereo audio signals into HA/CI. EHIMA admits this process is taking longer than expected.

Consumer organizations (International Federation of Hard of Hearing People, the Hearing Loss Association of America and the European Federation of Hard of Hearing) while excited about what the future will bring, are concerned that premature announcements will discourage research in TCs and lead to HL/ALS neglect and abandonment well before such a new technology is fully matured and carefully evaluated by end users.

While an accurate time estimate of a worldwide transition from an analog to a digital audio streaming system cannot currently be made, it is reasonable to believe that TC, HL/ALS usage will continue for the next 10-15 years and beyond.

HA/CI users require continued quality hearing access in public places which is currently, and in the foreseeable future, provided by TC and HL/ALS. The rights of HA/CI users to access must be continued and maintained during this period of technological change and shall not be compromised by the promise and overly optimistic expectations of a future technology development.

References:

1: www.access-board.gov/research/completed-research/large-area-assistive-listening-systems/1-introduction

2: <https://hearinghealthmatters.org/hearingnewswatch/2014/hearing-industry-seeks-new-wireless-standard-hearing-aids:t-coil-advocates-say-fast/>

June 2019

[The International Hearing Access Committee](#) (IHAC) is a subcommittee of the [International Federation of Hard of Hearing People](#) (IFHOH).

The aims of the Committee are:

1. To foster a greater understanding and awareness of the benefits of accessible technology and sound systems for persons with hearing loss with particular attention paid to hearing loop technology
2. To further developments for hearing technology and hearing loop technology use and availability as well as continual improvements in technology
3. To foster improved telecoil function and innovative application and raise awareness of its benefits among the providers in the hearing industry providers.



A Poem Tribute to HLAA East Bay Chapter Members

NOT LONG AGO

Not long ago,
when all our five senses are healthy
we were geared to pursue our dreams...
Through fertile our lives landscapes
where each layer feeds into next its immutable.

Not long ago,
we were too busy living the life larger than itself
we forget to slow down when we should have...
Until mother nature snared us a warning sign
A blurry vision, hearing difficulties on the phone, etc.

Not long ago,
We thought we had a long life ahead
It is merely 4,000 weeks of life expectancy...
The vanishing ages make us vulnerable
it's time to focus on now, no more "Not long ago".

Suzanne Yamamoto October 2021.

East Bay Leadership Team

The chapter is run by a Steering Committee, Leader Dale Davis, ddavis94605@gmail.com, who also oversees the Membership Database.

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JOIN THE HEARING LOSS ASSOCIATION OF AMERICA – THEY ADVOCATE FOR YOU!

Go to this URL to join today: <https://www.hearingloss.org/make-an-impact/become-a-memberrenew/>
OR, if you prefer to pay by check or card thru the mail, Nancy Asmundson has membership forms to send to you, or contact HLAA at 301-657-2248 or e-mail membership@hearingloss.org. Your membership form & payment go to HLAA, 6116 Executive Blvd., Suite 320, Rockville, MD 20852.

COSTS: Regular Membership/year (will receive *Hearing Life* magazine in print and digital format):

Individual - \$45; Couple/Family - \$55; Professional - \$80; Nonprofit - \$80;

Online Membership receives *Hearing Life* mag. in digital format only: Individual - \$35; Student - \$25.

Veteran Membership: Complimentary one-year Regular Membership & Lifetime Online Membership.