DUAL MICROPHONE DIRECTIONALITY

Since the first generation sound processor from Cochlear, standard fixed hardware directional microphones have been used to enhance recipients' ability to hear in noisy environments. Research throughout the hearing healthcare industry has repeatedly demonstrated the benefits of directional microphones when listening in noise.[1,2] Cochlear™ Nucleus® Systems remain the only cochlear implant systems on the market that deliver more than one type of directional capability in every sound processor. With the Cochlear Nucleus 6 System, synchronized dual microphone technology enables algorithms to manage different noise environments with the aim to improve hearing in noise for every recipient.

SIGNAL PROCESSING PATH

The implementation of dual microphone technology in the Cochlear Nucleus 6 Sound Processor incorporates two omni-directional microphones that are precisely calibrated to +/- 1 dB tolerance to ensure accuracy and consistency. In addition, the two microphones are phase matched. Low noise microphones are combined into selected directional responses using digital signal processing. Dual microphone technology provides an enhanced suite of directionality; Standard Directionality, Adaptive Beamforming (Beam®) and Fixed Directionality (Zoom) for improved listening in noise.

HOW IT WORKS

BEAM

Beam is for the most difficult listening situations, where noise is moving all around and we are particularly interested in listening to a specific conversation.

Two microphones can give us a lot of information about the sound environment such as the direction that sounds come from. This information can then be used to reduce the level of competing background noise. The basic principle of using the direction that sounds are coming from is called beam forming; an advanced version called Beam, is used in the Nucleus 6 System. Beam is good at reducing all types of noise. The basic principle is based on the direction that the sound comes from, not the type of noise that it is. For example, whether competing noise comes from a refrigerator or a competing talker; Beam is good at reducing both.

The Beam algorithm has maximum sensitivity at 0 degrees and maximum suppression between 90 and -270 degrees and can track multiple noise sources at different frequencies, at the same time; that is the noise cancellation is adaptive. The null point follows the noise source or the loudest noise source if there are several different noise sources in the area, making it an ideal choice for a situation in which the noise source, or recipient, are moving. The speed at which Beam adapts is about three seconds based on any change in the environment. Once in a specific environment, the algorithm can track smaller changes faster as needed. For example, if a competing talker changes location then the adaptive beam former can track the change. Beam will reduce the level of background noise, but it won't completely remove it altogether. For example, if there is a competing conversation behind the recipient, Beam will reduce the level of that competing conversation up to 15 dB, which is enough to reduce that conversation to a whisper.

1 Amlani, A. (2001). Efficacy of directional microphone hearing aids: a meta-analytic perspective. J Am Acad Audiol, 12, 202 – 214.
2 Bentler, R. (2005). Effectiveness of directional microphones and noise reduction schemes in hearing aids: a systematic review of the evidence. J Am Acad Audiol, 16, 473 – 484.

FIXED DIRECTIONALITY (ZOOM)

Listeners with normal hearing in a noisy environment get an advantage from their outer ear or pinna, to help reduce background noise. SmartSound® processing is designed to help cochlear implant recipients hear in noise. Using the dual microphones, a cone of sound is created in the front direction while reducing the level of noise from the sides and back of the listener. A fixed directional microphone or a fixed beam former is used to zoom in to focus attention on what the recipient wants to hear while the background noise is reduced (Fig. 1).

A single omnidirectional microphone is sensitive to all directions by the same amount. But with two microphones and SmartSound digital signal processing, we create directionality, which means the microphones can be less sensitive to sounds from the back and more sensitive to sounds from the front. The fixed directionality is configured to have maximum attenuation to the back diagonal having a pattern of 2 fixed nulls with maximum attenuation at 120 and 240 degrees with attenuation about 15 dB.

STANDARD DIRECTIONALITY

When not in a noisy situation, a directionality called standard directionality lets the recipient hear sound that is all around in the environment. The standard directionality pattern uses two microphones (Fig. 1). The two microphones are configured so that there is a mild attenuation of up to 5 dB from the rear. Standard directionality used in quiet environments for appreciation of the background ambience; it's used in quiet speech environments so that there's awareness of background sounds in the environment. It can also be used when listening to music.

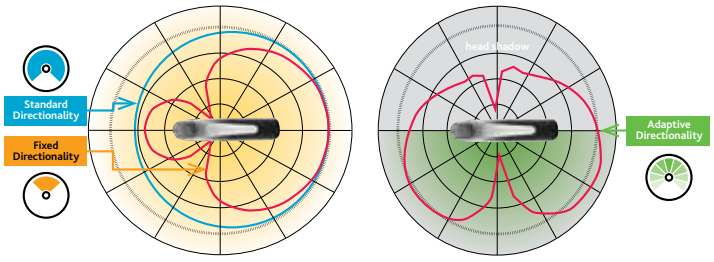

FIGURE 1

FIGURE 2

WHY IT MATTERS

People with normal hearing can locate where various sounds are coming from, focus on a specific speaker, pay attention to soft sounds and ignore sounds that are not important. Hearing loss negatively impacts the dynamic processes of normal hearing, thus making it very difficult for hearing-impaired individuals to hear some sounds, to understand speech in noise, or to ignore unwanted or unimportant sounds in their listening environment. The Nucleus 6 System includes SmartSound processing; that takes advantage of dual microphone directionality to help recipients hear more clearly even in the most challenging listening environments.

STANDARD

A standard, fixed directional microphone is sensitive to sounds from all around, but there is a small amount (about 5 dB) of attenuation for sounds from behind the listener. This means that sounds originating from the direction the listener is facing are amplified more than sounds from behind or in other directions (more like in normal hearing listeners). This setting is good for quiet, music or windy environments.

ADAPTIVE BEAM

Adaptive Beam reduces competing noise from several different sources in the area. It is ideal for a situation in which the noise source, or cochlear recipient, are in motion (Fig. 2).

FIXED ZOOM

A fixed super-directional microphone setting constantly blocks sound from behind and to the sides of the listener, allowing for easier understanding in noisy environments. This setting is good for situations when the desired signal is relatively stationary and remains in front of the recipient and noise is behind the listener and is not moving.

Not all patients with hearing loss are candidates for cochlear implantation. Cochlear implantation is a surgical procedure, and carries with it the risks typical for surgery.
For complete information regarding indications, warnings and adverse effects, please refer to the Nucleus Package Insert available at www.Cochlear.com/US/NucleusIndications.

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