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Tibbetts Industries

Far-Field Canceling (FFC) Telecoil Technology

A new approach to reducing telecoil interference

By Bowen Marshall, Principal Design Engineer, Tibbetts Industries

Low satisfaction in telephone use

A November 2002 *Knowles MarkeTrak VI*¹ study investigated what improvements in hearing instruments most current users would appreciate. The study's author, Sergei Kochkin, reports that more than eight out of ten consumers would welcome improved performance in understanding speech on the telephone. In fact, only 38% of users are satisfied with their telephone hearing experience. Tibbetts Industries believes that the increased use of telecoils and improvements in telecoil technology could improve the level of user satisfaction.

Telecoils – the common solution

The loudspeaker in a telephone earpiece generates an acoustic output that can be detected by a hearing aid microphone. This acoustic signal, however, is subject to background noise and acoustic feedback resulting in degraded intelligibility. Although some manufacturers employ signal-processing techniques to minimize feedback, excluding background acoustic noise remains a problem, particularly with behind-the-ear aids.

Fortunately, the same signal that generates acoustic output also generates an electromagnetic field fluctuating in direct proportion to the acoustic output. An optional hearing aid component known as a telecoil -- or t-coil -- can sense this fluctuating field. This allows a telecoil-enabled hearing aid to reproduce sound directly from a telephone's electromagnetic field without acoustic background noise or acoustic feedback. Hearing aids containing telecoils can significantly improve the quality of the patient's telephonic speech comprehension.

As telecoils have proliferated, the industry has developed a variety of assistive listening systems that use electromagnetic fields to carry signals to hearing aids. These include both interpersonal assistive listening systems and

room loop systems installed in public spaces such as theaters, auditoriums, or houses of worship.

Interference – the common problem

Interference caused by stray magnetic fields can create a problem for telecoil use. In fact, this interference has been a primary complaint of users and is probably a significant deterrent to more widespread telecoil use. The pervasiveness of electronic devices in everyday life is only increasing the prevalence of stray magnetic fields and the problems they cause.

Common sources of telecoil interference include electrical transmission and distribution lines, fluorescent light fixtures, industrial equipment, appliances, computers, and other electrical and electronic equipment. Although stray fields from these sources are generally in the 50 to 400 Hz range and are perceived as buzzing and/or humming sounds, interference in some instances can extend to 10 kHz or beyond and is manifested as hissing or other higher-pitched noises.

In analog hearing instruments, high-pass filters have traditionally been used to attenuate the low-frequency noise components. The long time constants required make this approach inflexible and cumbersome -- especially for multi-pole filters. Advanced digital signal processors (DSPs) use various noise-reduction algorithms to attenuate certain interfering signals. Yet effectively recognizing and minimizing the noise from myriad sources of electromagnetic interference that vary in time and space without degrading important speech information is still an important and difficult task.

At this time, it is not clear which DSP strategies will best improve speech comprehension or listening satisfaction, but it seems reasonable to assume that any method that attenuates noise without affecting speech will be perceived as a benefit by users.² Furthermore, if a hearing aid wearer chooses to use his or her t-coil for a phone conversation within the field of a room-loop system, DSP cannot distinguish one source of speech from the other. It is clear that a different approach to the problem of noise from electromagnetic sources could be beneficial in many situations.

Far-field canceling telecoils

Because the sources of interfering magnetic fields are generally located at some distance (several feet or more) from the hearing aid's telecoil, the field strength of these "far-field" sources is relatively uniform within the shell of the aid. Researchers at Tibbetts Industries have been developing an approach to the mitigation of this uniform interference with "far-field canceling" (FFC) telecoil technology.

Through extensive experimentation and testing at Tibbetts, the concept of using cancellation techniques to attenuate telecoil response to interfering fields has been shown to be effective. Far-field canceling telecoil assemblies have demonstrated dramatic reductions in interfering fields compared to standard telecoil geometry. Attenuation of audio band interference exceeding 40 dB (100:1) has been achieved.

A 40-dB decrease in sound pressure level is roughly equivalent to going from a very loud rock band to soft classical music or from the noise inside the NY subway to a quiet conversation. (To fully appreciate the noise reduction FFC telecoils can achieve in electromagnetically noisy environments, visit www.tibbettsindustries.com/technical/ffc. This link offers a brief soundtrack comparing the performance of an FFC coil and a standard telecoil in the presence of electromagnetic interference.)

In addition to enhancing the telephone experience for hearing aid wearers, FFC technology will enhance the user's experience of assistive listening systems that use electromagnetic fields generated in close proximity to the hearing aid to carry signals. Examples of such devices include Sensorcom's "T-link" (www.sensorcom.com) and a variety of devices marketed by HATIS (www.hatis.com).

Furthermore, if the hearing aid manufacturer provides a switch, FFC telecoils are compatible with both room-loop assistive listening systems and "Touchless Telecoil" technology. Because the loop-system transmission is itself a far-field signal, the user must disable the FFC functionality to access a loop-system signal. A single switch on the hearing aid would accomplish this in one

position while allowing the convenience of "Touchless Telecoil" functionality in the other.

A secondary benefit would be the ability to use the FFC telecoil for phone calls within the confines of a room loop without interference from the loop signal. In addition, because the FFC coil offers virtually the same telephone sensitivity in a vertical orientation as it does horizontally, it can be oriented vertically to optimize loop sensitivity (with FFC switched off) without sacrificing performance in the telephone mode.

Once optimized for general use, an FFC telecoil could be integrated easily into the hearing aid manufacturing process. Because of its slightly larger size, it is currently best suited for behind-the-ear and larger in-the-ear aids. But most importantly, it would offer an impressive reduction of wide-band magnetic interference signals in telephone use, enhancing the quality of life for a higher percentage of hearing aid users.

For a demonstration of FFC telecoil performance, please visit
www.tibbettsindustries.com/technical/ffc

References

¹ Sergei Kochkin, "MarkeTrak VI: Consumers Rate Improvements Sought in Hearing Instruments," *The Hearing Review* 9, no. 11 (November 2002)

² Donald J. Schum, "Noise Reduction via Signal Processing: Strategies used in Other Industries," *The Hearing Journal* 56, no. 5 (May 2003): 27-32; Donald J. Schum, "Noise Reduction via Signal Processing: Goals and Current Strategies," *The Hearing Journal* 56, no. 6 (June 2003): 32-41; Nancy Tellier et al., "Speech or Noise? Using Signal Detection and Noise Reduction," *The Hearing Review* 10, no. 5 (June 2003): 48-51; Ruth A. Bentler, "Digital Noise Reduction: (A Little) Beyond the Basics" (Presented at the American Academy of Audiology 2003 Annual Conference, April 3, 2003), FS101.

Author's Profile

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