Development of a Continuous Hearing Health Monitoring System

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Context

30 million workers in North America are susceptible to occupational noise-induced hearing loss (NIHL)\cite{1}.

In hearing conservation programs, worker’s hearing health status is only updated once a year.

Problem

Currently, no system is designed to continuously monitor hearing health in a noisy environment.

Objectives

- Develop a device to detect the early onset of hearing fatigue.
- Establish a “noise dose ↔ ear response” relationship.
- Define the individual’s susceptibility to noise.
- Prevent hearing loss.

Proposed Approach : DPOAE

Distortion product otoacoustic emissions (DPOAEs):

- small acoustical signals generated inside the cochlea ($f_{0}$) in response to two pure tone stimuli ($f_{1}, f_{2}$);
- used to detect, at an early stage, the onset of hearing loss.

A portable DPOAE monitoring system using adaptive noise rejection\cite{2} and robust signal extraction algorithms was designed to measure the inner-ear response in noisy environments.

The upcoming version of the system will include in-ear dosimetry to automatically establish the dose-response relationship and warn the worker when the DPOAE measurement should be done, to prevent hearing damage.

Experimental results

Preliminary measurements showing agreement between the designed system in 70 dB(A) white noise conditions and silent conditions compared to a commercial system in the same human ear. The cavity measurement shows an example of noise floor with the designed system when no DPOAE is present, confirming that a true DPOAE was detected in the human ear previously.

References
