Context
Over 22 million North American workers are exposed daily to noise doses that may induce hearing loss [1].

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

Current legislation does not consider the differences in individuals’ susceptibility to Noise Induced Hearing Loss (NIHL) nor the various characteristics of the noise such as the frequency spectrum and level variations over time.

As a result, NIHL remains one of the biggest causes of invalidity and indemnity in North America [1].

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

Therefore, hearing health is usually tested after the damage is irreversible.

Research 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.

Experimental Results
Typical timeline of exposure noise level (top) synchronized with DPOAE variations at 5 different f2(2f1-f2) test frequencies measured with the developed system during an experiment on a human participant (bottom). Blank data points for certain frequencies result from the post-processing threshold method removing outliers.

DPOAE levels decrease towards the end of the L8h = 82 dBA noise exposure and after this exposure they recover to pre-exposure DPOAE levels, or higher, as shown in the red circle. This variation in DPOAE levels indicates that the noise exposure had an effect on cochlear activity which could potentially result in hearing damage if the noise exposure duration or level is increased.

Benefits of the proposed approach
• Provide a reliable tool for scientists to conduct research on hearing recovery mechanisms.
• Warn workers of their hearing fatigue before hearing loss is irreversible.
• Define appropriate legislation to protect workers against occupational NIHL.
• Reduce indemnity paid to workers due to hearing loss.

Proposed Approach : DPOAE
Distortion product otoacoustic emissions (DPOAEs):
• small acoustical signals generated inside the cochlea (f0) in response to two pure tone stimuli (f1,f2);
• used to detect, at an early stage, the onset of hearing loss.

References