Protective Equipment

Wearable Noise Dosimetry for Tactical Environments

In theater, exposure to hazardous noise levels is a known threat to Service Members; however, it is difficult to obtain individualized characterizations of such exposure in tactical environments. To address the lack of data, the Bioengineering Systems and Technologies Group at the Massachusetts Institute of Technology (MIT) Lincoln Laboratory successfully fielded prototype helmet-mounted and modified commercial off-the-shelf acoustic sensors in August 2013 through collaborations with the Marine Expeditionary Rifle Squad and US Army Research Institute of Environmental Medicine (USARIEM). The sensor was designed specifically to collect high decibel-level noise and was hardened for tactical data collection during US Marine Corps dismounted operations out of Patrol Base Boldak, Afghanistan. To maintain operational security, speech content was removed from the recorded data, while the relevant noise exposure information was preserved. The 274 hours of combat audio data collected in Afghanistan by 19 Marine volunteers captured their exposure to vehicle noise and weapons fire. Analysis of the data by MIT Lincoln Laboratory in FY14 revealed that the majority of the Marine volunteers were exposed to noise conditions exceeding 85 A-weighted decibels, the safety threshold set by the National Institute for Occupational Safety and Health, over the course of a two-day collection period. In addition, several Marines were exposed to noise conditions that greatly exceeded the 500 auditory risk unit (ARU) impulse noise limit set by Military standard (MIL-STD) 1474E.[1] During one firefight that occurred during the data collection period, one Marine's exposure even exceed 2500 ARUs. In FY15, development started on a second-generation prototype wearable device funded by the Marine Expeditionary Rifle Squad and the US Army Natick Soldier Research and Development and Engineering Center (NSRDEC). The new device incorporates improvements such as a higher sampling rate, expanded dynamic range, onboard processing to provide real-time exposure metrics, global position system, and wireless connectivity capabilities. Continued development and validation testing of the second-generation prototype began in March 2016. The Office of Naval Research (ONR) has also taken the lead to field the device in order to support an existing US Marine Corps/Navy study of hearing injury sustained during Marine rifle training exercises. The ongoing work to collect individualized exposure data will help to more accurately quantify its complex relationship with hearing injury. Results will ultimately enable the development of more accurate exposure limits and hearing protection criteria for combat environments, which could help reduce the risk of hearing loss and increase hearing protection usage compliance.

1 Department of Defense Design Criteria Standard Noise Limits. MIL-STD-1474E. (2015) https://www.arl.army.mil/ www/pages/343/MIL-STD-1474E-Final-15Apr2015.pdf