COMPARISON OF WEARABLE WIRELESS BLAST SENSOR TECHNOLOGIES

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Abstract: In operations and training, U.S. military personnel are exposed to blast overpressure from multiple sources that include improvised explosive devices, ordnance (breach explosives, hand grenades), and weaponry (heavy shoulder-fired weapons, high-powered rifles) that may lead to neurological and performance deficits. Given the concerns regarding the acute and long-term effects of cumulative blast exposure on brain health, several National Defense Authorization Acts (NDAAs 2018, 2019, & 2020) required the Department of Defense to study blast, and include blast exposure history in medical records of members of the Armed Forces (AF). The purpose of this study is to compare the accuracy and sensitivity of wearable blast sensors in a controlled environment using an advanced blast simulator at varied pressures.

Five wearable sensors, including two commercially available [MED ENG Blast Tracker 1 (BT1) and Black Box Biometrics (B3) Gen 7)], and three developmental phase sensors [MED ENG Blast Tracker 2 (BT2), L3 Technologies Blast Dosimeter (LB) and Advanced Materials and Devices (AMAD) OmniBlast Air (OB)] were exposed to blast waves of varying intensities (2-20 psi) with an advanced blast simulator that produces free-field like blast. A pitot tube with incident and stagnation pressure sensors was used as the gold standard to record the critical ambient blast wave loading with 800,000 samples/sec sampling rate. The sensors were oriented in the ABS at three orientations: 0˚, 45˚, and 90˚ in relation to the oncoming blast wave and tested simultaneously (at least n =3 per each condition). Absolute differences in the under 12 psi group (average static pressure of ~7.05psi) when compared to the static gauge recordings for BT1, BT2, B3, OB, and L3 were 0.39, 0.87, 0.46, 0.85, and 1.13 psi, respectively. Groups above 12 psi (average ~16.37psi static), had variability ranges from 5-15% compared to static; absolutely average difference for BT1, BT2, B3, OB, and L3 were 4.37, 3.34, 3.27, 2.59 and 3.13, respectively. Stagnation pressure had similar trends for pressures up to 16.34 psi. However, stagnation pressures averaging 43 psi, had variability ranging from ~26%-40% depending upon the sensor.

Wearable gauges performed relatively well (<5% variability) up to 12psi static pressures. Variability increased with increase in pressure. OB performed well up to 16 psi. Differences in this variability could be partly attributed to the sampling rate, which varied with each sensor. Additionally, analyses for impulse and other factors such as responses of multiple sensors in a gauge is currently underway.