

USING GPS TO IDENTIFY WHOLE-BODY VIBRATION EXPOSURES WHEN OPERATING MINE/QUARRY HAUL TRUCKS

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Introduction

Miller et al. (2004, 2000)^{1,2} reported on investigations to monitor and minimize haul truck driver exposures for jarring/jolting (mechanical shock) using GPS data. Their work led to the development of a “black box” called a “Shox Box” installed on equipment that already had a GPS system onboard. This device with accompanying software provided a means for objectively assessing jarring/jolting and a means for determining its root cause. Mayton et al. (2014)³ reported on whole-body vibration (WBV) exposures and influencing factors for quarry haul truck drivers and loader operators and looked at WBV exposure while traveling with and without a load of material between loading and dumping areas of two quarries. They noted that WBV, measured at the cab floor/frame and at the driver/seat interface, was significantly lower for the loaded compared to the unloaded condition. In the light of these investigations, researchers more recently examined WBV relative to four haul truck activities including dumping, loading, and traveling with and without a load. One objective was to see how haul truck WBV exposure related to a particular activity and whether one or more of the activities posed a greater exposure than the others.

Methods

Using a LMS SCADAS SCR05-16 data recorder, WBV and GPS data were collected for seven vehicles and drivers/operators operating at each of the four surface mines/quarries. The accelerometers were used to record triaxial vibration on the floor of the driver’s cab and on the driver’s seat. A trigger pulse was used to mark the data files and identify the haul truck activities – loading, dumping, traveling with no load, and traveling with full load. One button press denoted entering and exiting the loading area and two button presses denoted entering and exiting the dumping area. The NIOSH researcher riding in the haul truck visually selected a landmark along the ramp or section of the roadway leading to the dumping/loading areas and pressed the trigger button each time the haul truck reached that location. In most cases, dumping/loading contained a small portion of the data with the haul truck traveling short distances with and without a load prior to and after actual dumping or loading took place. Some data points were extrapolated where necessary. The following results show a case study from one subject that provides an example of the how GPS and trigger data can help explain high levels of WBV exposure.

Results

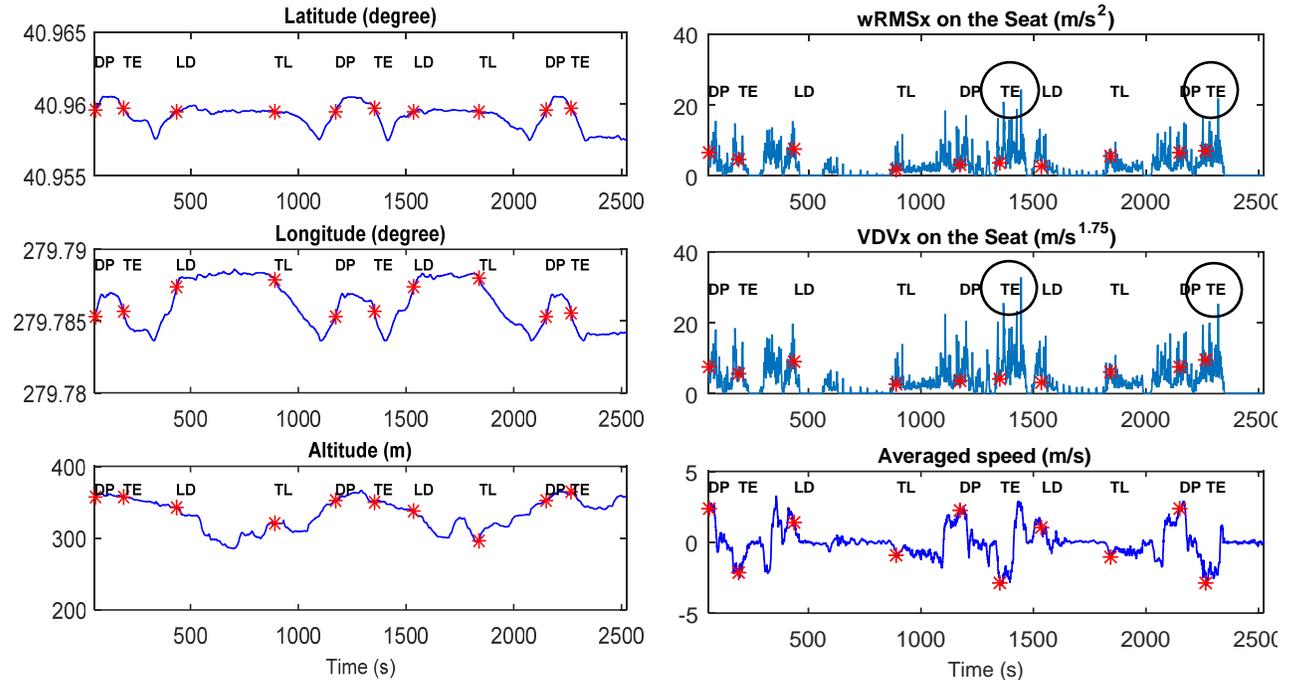


Figure 1 – The starting points for the haul truck activities are noted on each of the above graphs as DP - dumping, LD - loading, TL - traveling loaded, TE - traveling empty. Latitude, longitude, and altitude (or elevation) are shown in the left column; whereas, the right column shows wRMS, VDV, and average speed.

Discussion

High wRMS accelerations and VDV levels in the X-direction (fore-aft) were identified for the case selected that exceeded the ISO/ANSI Health Guidance Caution Zone (HGCZ) by more than 5 to 6 times the exposure level for an 8-hour shift. Levels of wRMS and VDV for the Y- and Z-axes appeared below the same HGCZ. The review of trigger and GPS data together with field notes from the passenger riding in the haul truck pointed to wRMS and VDV peaks that occurred for the traveling empty activity shown in Figure 1. Consequently, researchers concluded that these high levels occurred as the haul truck descended down grade into the pit loading area, sliding at times, on a wet and slippery road surface caused by rain during the day.

References

1. Miller, R.E., Lowe, N.T., and Thompson, R. (2004). A GPS-based system for minimizing jolts to heavy equipment operators. Washington, DC: U.S. Department of Health and Human Services, CDC, NIOSH, Office of Mine Safety and Health Research. Retrieved Mar. 2, 2016, from www.cdc.gov/
2. Miller, R.E., Boman, P., Walden, J., Rhoades, S., and Gibbs, R. (2000). Acceleration and GPS data monitor truck-haulage jolts. *Mining Engineering*, 52(8), 20-22.
3. Mayton A.G., Jobes C.C., and Gallagher S. (2014). Assessment of Whole-Body Vibration Exposures and Influencing Factors for Quarry Haul Truck Drivers and Loader Operators. *International Journal of Heavy Vehicle Systems*, Vol. 21, No. 3, 241-261.



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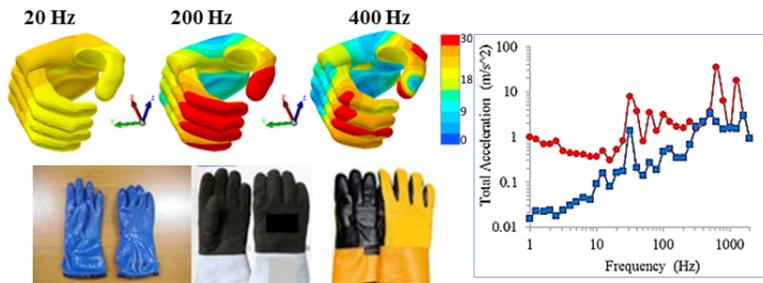


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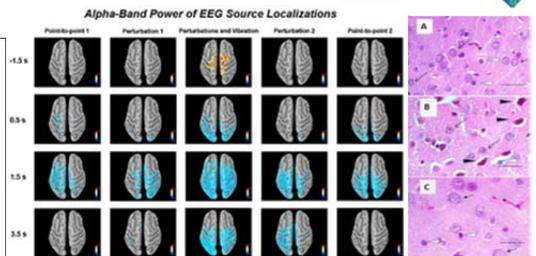
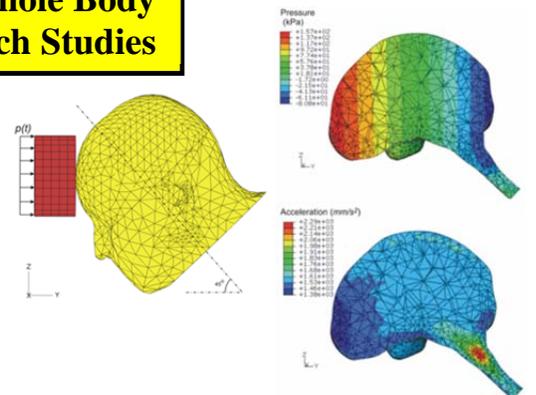
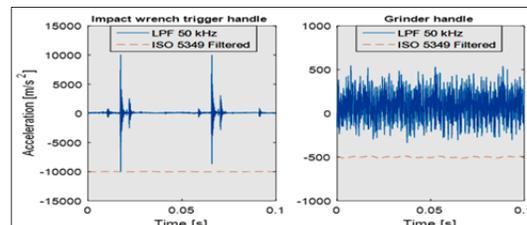
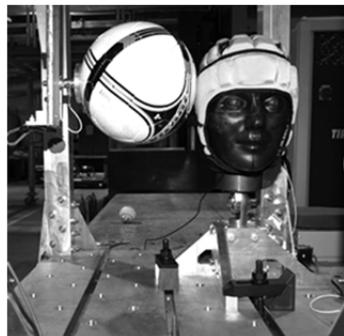
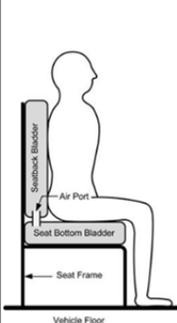


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