Computational Modeling Related to Blast Exposure

Ocular Tissue Injury as a Function of Blast Exposure: A Computational Fluid Dynamics Model

Researchers at the U.S. Army Aeromedical Research Laboratory (Fort Rucker, Alabama) are conducting a study to develop a computational model to analyze the interaction between the blast wave and protective eyewear and to predict stresses and deformations on the eye as a function of blast overpressure. Previous studies using a high-pressure shock tube have revealed turbulent interactions between the eye and protective eyewear at nonzero blast orientations which amplify the pressure at the eye (*Williams et al. 2016, Williams et al. 2017*). A computational fluid dynamics model developed in coordination with the Biotechnology High Performance Computing Software Applications Institute (Frederick, Maryland) has revealed the physics behind these interactions at various blast orientations which could lead to improvements in eyewear design to mitigate these effects. Another model evaluating ocular tissue response to blast loading has been developed to predict ocular injuries as a function of blast overpressure. These models have revealed that pressure loading at the eye for head-on blasts was largely contributed by reflections from the eye, forehead, and cheek. At oblique orientations, large secondary loading on the far eye was observed. Reflections from the inside of the spectacles were due to gaps between the eyewear and the face. Goggles eliminated these reflections but produced higher positive phase durations at the eye due to pressure being trapped within the eyewear (*Williams et al. 2017;* Figure 1).

FIGURE 1: Four sets of eyewear tested. (1) Revision Sawfly, (2) Wiley X Talon, (3) Uvex Genesis, and (4) Arena Flakjak. (Figure from Williams et al. (2017) used with permission from the authors)

This modeling effort provided protection criteria from which to design eyewear to protect Service members from the effects of blast waves.

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REFERENCES:

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