Computational Modeling Related to Blast Exposure

Blast-Induced Injuries to the Dismounted Soldier

Researchers at Weapons and Materials Research Directorate (WMRD) within the Army Research Laboratory (ARL) are working to address the prevalence and severity of soft tissue injuries to dismounted Service members during non-fragmenting, buried blast events. Their aim in this project is to determine how the fabric of combat uniforms degrades during blast events as it is the only thing protecting the extremities of Service members from high-velocity soil particles. They approached this problem with both modeling and experimental techniques.

On the modeling side, they are developing soil particle and fabric models that can inform the intricacies of their interactions. A model of the uniform fabric has been created using geometry measured from microscopy images. Impact from simplified soil modeled as particle elements has been performed on a yarn level and fabric level textile model. The model can show differences in stress localization and particle interactions when impacted directly or from an oblique angle. Preliminary simulation results indicate the potential for increased damage of the fabric from soil loading at an oblique angle.

On the experimental side, they are conducting arena experiments to measure the velocity, trajectory, and duration of soil spray. Engagement parameters have been determined and deployed in arena experiments designed to facilitate measurement of soil velocity and trajectory. The researchers intend to use these data to inform the construction of smaller scale methods of propelling soil at realistic velocities for the relevant durations. This smaller scale experimental technique will be used to further inform model development with the end goal of providing information regarding fabric vulnerability, and therefore, fabric survivability, to be used develop novel fabrics.

These models and experimental data will be shared with the Natick Soldier Research, Development and Engineering Center to integrate this applied research with their textiles/fiber science efforts that will enable the development, testing and fielding of personal protective clothing.

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