



US DEPARTMENT OF DEFENSE

BLAST INJURY RESEARCH PROGRAM COORDINATING OFFICE

Models of Blast Injury: Warrior Injury Assessment Manikin (WIAMan) Program

Finite Element Model Development for Next Generation Test Manikin

The Warrior Injury Assessment Manikin (WIAMan) program at Army Research Laboratory (ARL; Adelphi, Maryland) continued to develop, evaluate, and apply a finite element model (FEM) capability for the WIAMan Anthropomorphic Test Device (ATD). The FEM is being developed to fulfill a requirement of the Live Fire Test and Evaluation (LFT&E) community for conducting pre-shot predictions and post-shot analyses of ground vehicles undergoing underbody blast (UBB) testing. The FEM is being developed for both the LS-DYNA and Velodyne solvers. In FY17, the WIAMan FEM was used to explore ATD functionality under laboratory test conditions and was also used within an FEM of a ground vehicle to simulate its response to blast-driven LFT&E conditions (Figure 1). The highly detailed FEM performed well under all conditions, and provided insight on ATD design and materials, sensor capacity, and its suitability for use by the LFT&E community. In the second half of FY17, the FEM was modified to match the design of the new WIAMan Gen 1 ATD that was received from Diversified Technical Systems in June 2017. The new Gen 1 FEM incorporates all design changes and features an updated model for the butyl rubber compliant material used in the cervical spine of the WIAMan Gen 1 ATD. A verification and validation (V&V) effort was initiated in preparation for transition of the FEM in FY18 to ARL-Survivability and Lethality Analysis Directorate who will incorporate it into their underbody blast methodology. A V&V plan is being prepared to satisfy acceptability criteria that have been defined through coordination with the Director, Operational Test and Evaluation; the Army Test and Evaluation Command; and ARL. To validate the Gen 1 Technology Demonstrator FEM, comparisons will be made between predictions and test data for a range of loading conditions and severities. The FEM will be refined based on these results, and the final version will be available during the second quarter of FY18. Once the Gen 1 FEM is complete, it will be used in conjunction with WIAMan injury assessment reference curves to make virtual predictions of skeletal injury in UBB loading conditions.

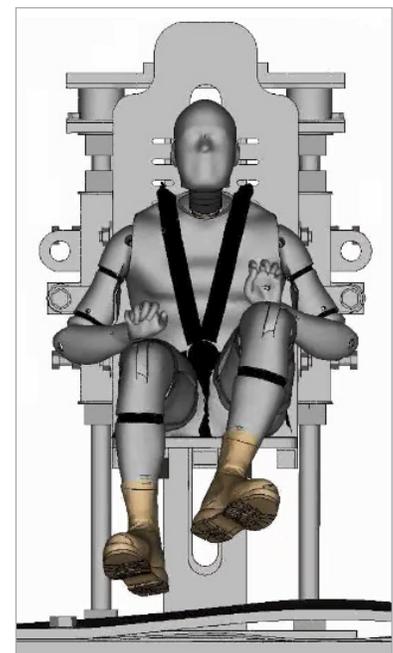


FIGURE 1: WIAMan FEM showing ATD response to a severe, blast-driven, vertical accelerative load on the ARL Accelerative Loading Fixture. (Figure used with permission from the authors)

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