Design and Development of an Energy Absorbing Seat and Ballistic Fabric Material Model to Reduce Crew Injury Caused by Acceleration From Mine/IED Blast

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Degree MS, University of Cincinnati, Engineering : Mechanical Engineering, 2006.

Abstract Anti tank mines pose a serious threat to the occupants of armored vehicles. High acceleration pulses and impact forces are transmitted to the occupant through vehicle-occupant contact interfaces posing the risk of fatality. The use of an energy absorbing seat in conjunction with vehicle armor plating greatly improves occupant survivability during such an explosion. The axial crushing of aluminum tubes over a steel rail constitutes the principal energy absorption mechanism. The explicit non-linear finite element software LSDYNA is used to perform all numerical simulations. The occupant is modeled using a HYBRID III dummy. Numerical simulations are also conducted of the dummy's foot impact by the floor whose upward motion is comparable to an armored vehicle's reaction to a mine blast. A simple numerical formulation is presented to predict the deceleration response during dynamic axial crushing of cylindrical tubes. The formulation uses an energy balance approach and is coded in MATLAB. It can be used for injury assessment and survivability studies. The impact resistance of high strength fabrics makes them desirable in applications involving protection against penetration. A material model based on a micromechanical approach has been developed to realistically simulate ballistic impact of loose woven fabrics with elastic crimped fibers. The material model is implemented in LSDYNA.

Keywords LSDYNA; Energy Absorbing Seat; HYBRID III Dummy; Axial Crushing; Material Model; Woven Fabrics; Kevlar; LS-DYNA; Ballistic Impact; Numerical Formulation; Mine Blast; Circular Tubes

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Pages 186p.