Comparison of Lower Leg RESPONSES USING Hybrid 3, THOR, and THUMS in simulated aircraft crashes

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ABSTRACT

Injuries to the lower extremities comprise the greatest proportion of injury to any body region due to survivable commercial and non-commercial aviation crashes. While injuries to the lower extremities are not usually associated with high morbidity, they can greatly hinder egress and reduce survivability in aircraft crashes. The anthropomorphic test devices (ATDs) currently used in seat testing have limited biofidelity and sensors that preclude the ability to adequately assess lower extremity injuries in aircraft crashes. Further, the stiffness and geometry of the abdomen, lumbar, and pelvis in the HII and FAA-HIII ATDs may result in less excursion than experienced by occupants. In this paper numerical modeling is used to compare the lower extremity responses of the Hybrid III, THOR, and THUMS during FAA-defined crash test conditions. The results indicate that the probability of some lower extremity injuries resulting from FAA-defined crash test protocols can potentially be evaluated using existing test hardware such as the advanced THOR lower leg. The effects surrogate stiffness and belt fit are investigated. The work also demonstrates the ability to predict the occurrence of lower extremity injury using numerical modeling techniques and finite element human body models. Coupling the results of physical testing, numerical modeling, and injury data provides a robust foundation for identifying and mitigating serious injuries in aviation incidents.