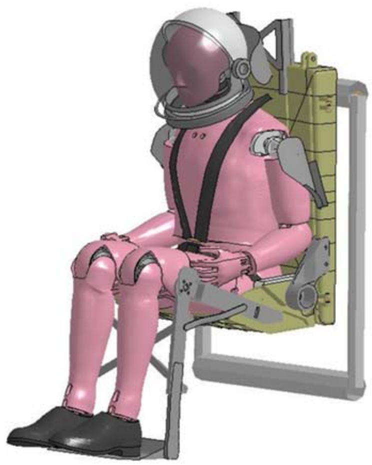
VALIDATION OF THE 5TH AND 95TH PERCENTILE HYBRID III ANTHROPOMORPHIC TEST DEVICE FINITE ELEMENT MODEL

C. Lawrence[1], J. T. Somers[2], M. A. Baldwin[3], J. A. Wells[4], N. Newby[2], N. J. Currie[5]
[1]NASA Glenn Research Center, Cleveland, OH
[2]Wyle Science, Technology and Engineering Group, Houston, TX
[3]Lockheed Martin, Denver, CO
[4]Lockheed Martin, Houston, TX
[5]NASA Johnson Space Center, Houston, TX

NASA spacecraft design requirements for occupant protection are a combination of the Brinkley criteria and injury metrics extracted from anthropomorphic test devices (ATD's). For the ATD injury metrics, the requirements specify the use of the 5th percentile female Hybrid III and the 95th percentile male Hybrid III. Furthermore, each of these ATD's is required to be fitted with an articulating pelvis and a straight spine. The articulating pelvis is necessary for the ATD to fit into spacecraft seats, while the straight spine is required as injury metrics for vertical accelerations are better defined for this configuration. The requirements require that physical testing be performed with both ATD's to demonstrate compliance. Before compliance testing can be conducted, extensive modeling and simulation are required to determine appropriate test conditions, simulate conditions not feasible for testing, and assess design features to better ensure compliance testing is successful.



95th percentile male Hybrid III in Orion seat

While finite element (FE) models are currently available for many of the physical ATD's, currently there are no complete models for either the 5th percentile female or the 95th percentile male Hybrid III with a straight spine and articulating pelvis. The purpose of this work is to assess the accuracy of the existing Livermore Software Technology Corporation's FE models of the 5th and 95th percentile ATD's. To perform this assessment, a series of tests will be performed at Wright Patterson Air Force Research Lab using their horizontal impact accelerator sled test facility. The ATD's will be placed in the Orion seat with a modified-advanced-crew-escape-system (MACES) pressure suit and helmet, and driven with loadings similar to what is expected for the actual Orion vehicle during landing, launch abort, and chute deployment. Test data will be compared to analytical predictions and modelling uncertainty factors will be determined for each injury metric. Additionally, the test data will be used to further improve the FE model, particularly in the areas of the ATD neck components, harness, and suit and helmet effects.