1st Place Winner and Runner-Up Project Abstracts

Winner

School: Virginia Tech - Wake Forest University Center for Injury Biomechanics, United States

Project Title: A Biofidelic Lung Surrogate for Anthropomorphic Test Devices to Predict Pulmonary Contusion Following Motor Vehicle Crash

Competition Category: Dummy Design and Instrumentation

Region: North America

Abstract
Pulmonary contusion (PC) is a major source of patient morbidity and mortality following Motor Vehicle Crash (MVC). Thoracic trauma is second only to head trauma in terms of frequency, with PC being the most commonly identified thoracic injury in trauma admissions. Yet current federal motor vehicle safety standards for thoracic injury rely on gross metrics (chest deflection and acceleration) for injury criteria, bypassing injuries sustained by specific thoracic organs. While controversial, the current criteria continue to be used for countermeasure design thanks in part to the ability to quantify these metrics with instrumented Anthropomorphic Test Devices (ATDs). The current proposal introduces a novel, biofidelic pulmonary surrogate intended for integration into currently-available ATDs. The proposed surrogate will augment conventional thoracic injury criteria by collecting organ-specific energy absorption data in terms of force and deflection. The instrumented surrogate will be a low-density foam rendering of 50th percentile male lungs. Geometry of the surrogate will be derived via computed tomography data and rapid prototyping. A combination of instrumentation including, but not limited to accelerometers, pressure transducers and/or pressure sensitive matting will be used for data collection. A high-speed data acquisition system, in conjunction with Matlab software will be used to collect and visualize data from the lung surrogate. The surrogate will be subjected to impact testing between 10-15 m/s. Clinical studies of PC have correlated 20% contusion by volume to an 80% increase in likelihood of developing Acute Respiratory Distress Syndrome, a potentially fatal consequence of PC. Current research at Wake Forest conducted by the investigators complements this effort by quantifying pulmonary contusion following MVC using data from the Crash Injury Research and Engineering Network (CIREN). This research is the critical link between the clinic and improved countermeasure design since the insult required to elicit contusion volume greater than 20% is not yet well characterized.