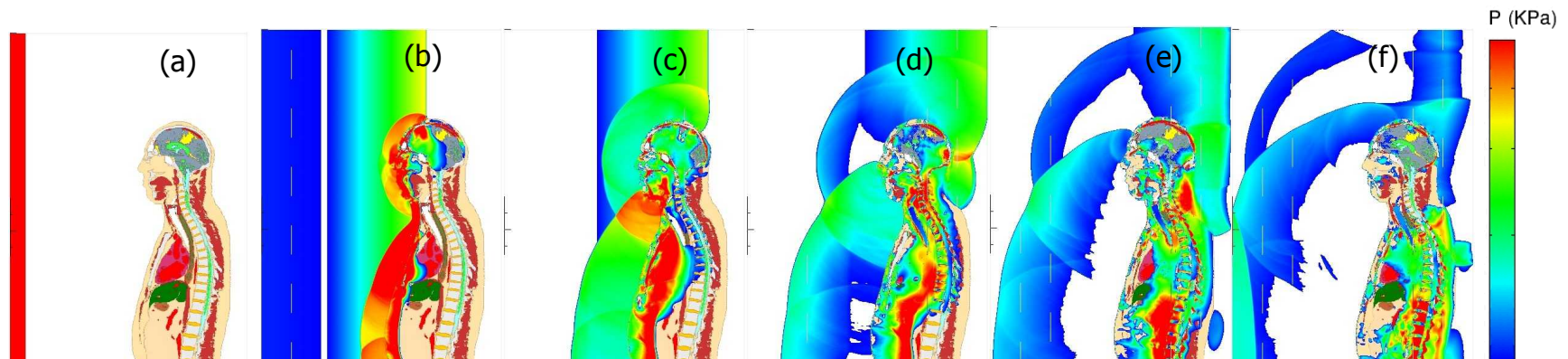


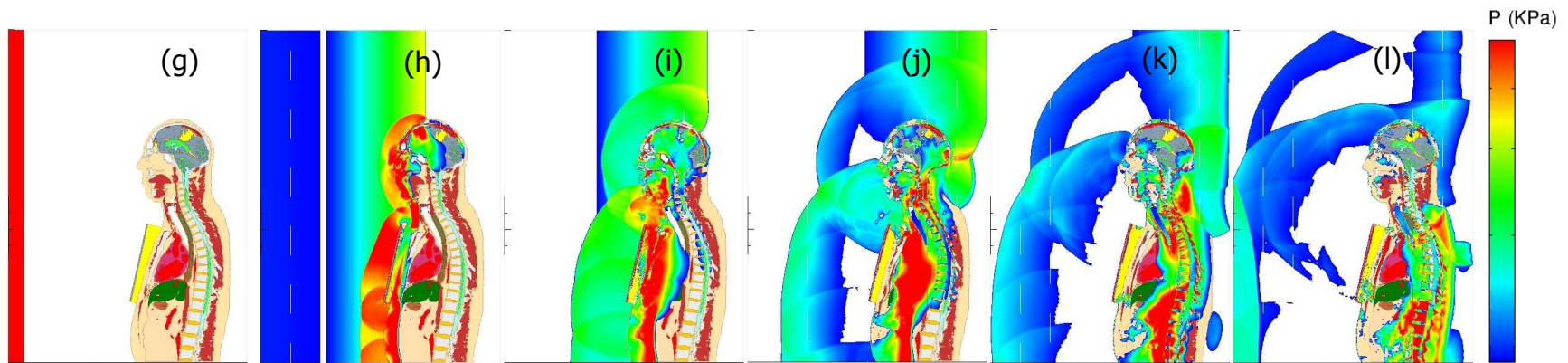
Simulation of Blast and Behind-Armor Blunt Trauma to Life-Critical Organs in the Human Body

Sandia Team Members: Paul A. Taylor and Candice F. Cooper

Researchers at Sandia National Laboratories have developed a high-fidelity virtual model of the human head, neck, and torso to investigate the details of life-threatening injury to the central nervous, respiratory, and cardiovascular systems as a result of blast exposure and behind-armor blunt trauma. This model set is comprised of separate head-neck and torso models that can be used independently or combined to investigate comprehensive injury to life-critical organs as a result of blast, blunt impact, and/or projectile penetration. The Sandia head-neck-torso model represents a 60th percentile human male from the waist up possessing anatomically correct distributions of bone, white and gray brain matter, falx & tentorium membranes, spinal cord, intervertebral disks, cartilage, vasculature, blood, airways, lungs, heart, liver, stomach, kidneys, spleen, muscle, and fat/skin.

This year, researchers built upon previous simulation capability by adding the ability to assess virtual armor protection of the torso model. The Sandia wave physics code CTH was used in conjunction with this model to simulate blast loading and ballistic projectile impact to a warfighter with and without protective armor, in order to investigate the details of injury to life-critical organs such as the brain, spinal cord, lungs, airways, heart, blood vessels, and liver as a result of the intrathoracic pressure waves that are generated from a blast or impact. These simulations can be used to assess new armor design and facilitate development of advanced armor.





Frontal blast wave exposure of Sandia Human Head-Neck-Torso Model unprotected (a-f) and with notional chest armor (g-l). (a & g) Initial setup. Blast wave is generated from reservoir (denoted in red) of high pressure air on left side of image. (b & h) Blast wave propagating to right with wave front impacting human model. (c & i) Blast wave has generated transmitted pressure waves into the body with reflected air wave traveling back towards blast source. (d-f) and (j-l): Time-evolution of wave transmission within the body and reflected wave in air. Differences in pressure plots between (a-f) and (g-l) are due to the presence of the chest armor. White space outside human model indicates regions experiencing pressures below 1.1 atmospheres (110 KPa) in magnitude.