

Computational Model

- 5th Percentile Male Torso

Market Need

According to the "Standards and Testing for Police Body Armor" published by the National Institute of Standards and Technology (NIST), body armor and protective gear is evaluated by firing rounds at the materials which are placed on blocks of modeling clay or a similar material. The clay block is examined after each round and the dents are measured. The severity of injuries which would correspond to the craters is estimated based loosely upon the crater depth, diameter and anecdotal evidence.

Unfortunately, most injuries experienced by soldiers or law enforcement officers are complex and often based upon multiple assaults and impacts. Evidence suggests that injuries are related to both direct and indirect effects of impact. While penetrating projectiles present obvious complications, it is unclear how other factors - such as shock waves - contribute to the injury. The homogeneous properties of a clay block can not demonstrate the relationships between the injury and impact site.

For example, when shot in the chest or abdomen, there may be internal injuries even though the projective gear may not have penetrated. This non-penetrating injury could go undetected until the person succumbs, for instance, to hemorrhaging in the lungs or laceration of the liver.

Better tools are needed to test and design more effective materials and products meant to protect the body against physical assaults.

APL Solution

To study injuries to internal organs and to assist in the design and testing of better military and para-military protection, researchers at The Johns Hopkins University Applied Physics Laboratory (JHU/APL) have developed a computational (finite element) model (FEM) to support and validate the JHU/APL patented physical human surrogate torso model (HSTM) - U.S. Patent No. 6,769,286.

Features

FEMs have been developed by other organizations; unfortunately, those models suffer from inadequate proportions and spatial relationships of the organs



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within the torso. They also lack accurate soft and hard tissue properties. The JHU/APL FEM of a 5th percentile male torso includes the skeleton (ribs, sternum, cartilage, and vertebral column) along with the heart, liver, lungs, stomach, muscle, and skin. Each component of the system is defined by its specific material properties. Bones have a defined stiffness and each internal organ (including viscera) has specific physical behaviors based on its biological composition and relative position in the torso.

Impact studies have been performed which validate the effectiveness and accuracy of this model. The model is able to demonstrate how an applied pressure (bullet, hockey puck or seat belt) directly affects the body and how that effect then travels through the body over time. Knowing the specific forces being experienced by each organ enables a user to precisely determine the expected levels of injury and their long-term significance.

Commercial Benefits

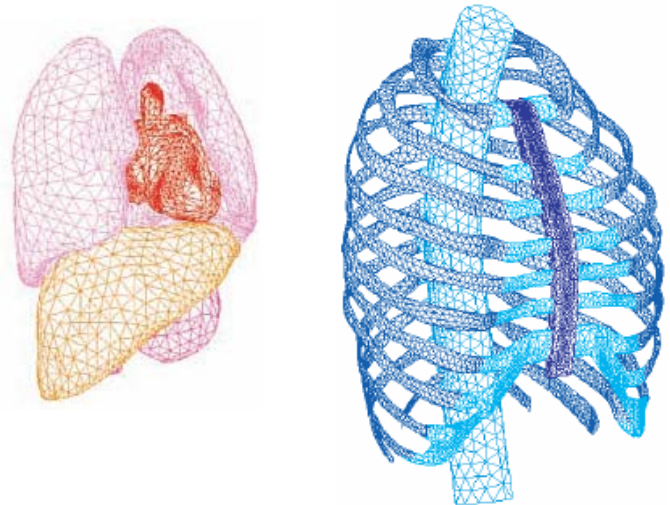
The JHU/APL Computational Model is useful for the development and testing of materials, techniques and products intended to protect the body - seen in the military, law enforcement, transportation and athletic industries. It has applications in the medical field, where the effects of new materials, procedures and devices are tested.

Technology Status

The Computational Model of the 5th Percentile Male Torso has been used to support Sponsor requests to better understand the impact from behind armor blunt trauma and to examine the effectiveness of body armor. JHU/APL continues to use this model for ongoing research, including the development of additional components (head and neck) and the 50th percentile Male Torso. University researchers have licensed this copyright protected compilation of data.

Key Features

- Uses LS-DYNA Software
- Musculoskeletal Structure
- Internal Organs
- >300,000 elements
- >55 different dynamic scenarios examined



Intellectual Property

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Availability

Available for licensing to qualified companies and organizations.

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