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Center for Injury Biomechanics announces $3M award

BLACKSBURG, Va., April 6, 2010 – The National Highway Traffic Safety Administration (NHTSA) has awarded $3 million over five years to the Center for Injury Biomechanics (CIB). The CIB is partnering in this effort with the Virginia Tech Transportation Institute (VTTI) through the Virginia Tech - Wake Forest University School of Biomedical Engineering and Sciences (VT/WFU SBES) to generate gender and age specific models for prediction of injury as a result of motor vehicle crashes.

VTTI Director Tom Dingus said, "We are pleased to continue to partner with the CIB and VT/WFU SBES and are particularly pleased to announce this project. Given the continuing, unacceptably high crash rate in the U.S., it is critical that we continue to be diligent in our efforts to find ways to predict and mitigate injury from motor vehicle crashes thereby effecting policy change to ultimately save lives."

Increased life expectancy and declining birth rates are projected to increase the portion of the U.S. population over age 65 by more than 20 percent by the year 2050, creating an urgent need for further research into the biomechanics of the aging body. Aging is associated with structural and morphological changes that can decrease the body's ability to withstand traumatic insults. The decreased skeletal and physiological resilience of the elderly make trauma and its after effects one of the top ten causes of death among those 65 and over, with motor vehicle crash as one of the most common sources of such trauma. Individuals in this age group have the second-highest crash-related death rate among all age groups.

Due to their versatility, computational models of the human body have emerged as a promising avenue for research aimed at improving the effectiveness of vehicle safety systems and mitigating crash-related injuries across all age groups. With the proper framework, not only the materials, but also the size and shape of these models, can be adjusted to match any population.

One component of this research program investigates brain injury mechanisms and post-injury biochemical cascades. A primary objective of this effort is to better establish the nature and time course of the brain's response after head impact, with focus on factors important to long-term functional deficit. High-speed biplane x-ray will be used to examine brain injury mechanics and magnetic resonance spectroscopy will be used to examine the chemistry of the brain. These techniques will be compared to more conventional histological findings on the cellular level.

Warren Hardy, director of Virginia Tech's CIB and an associate professor of mechanical engineering, says, "Traumatic brain injury continues to be costly to society in both monetary and human terms. The knowledge gained from this study will lead to a better understanding of injury tolerance and more effective approaches to injury prediction, mitigation, diagnosis, and treatment."

In previous studies, the CIB has developed morphing functions for the SIMon brain model such that its shape can be changed to reflect the brain of an infant, and can be changed so that it reflects a young adult. This project expansion involves extending the SIMon morphing project to the elderly, providing shape analysis and other information on the brain from ages 0 – 100. Also included as one of the task areas will be the development of a software package for automatic processing of clouds of landmark data and metadata representing brain anatomy and properties.

Certified scans of normal individuals from age 0 – 100 will be collected to observe the aging process via actual CT scans verified free of artifacts which might be expected to affect normal anatomy such as scoliosis, severe degenerative conditions, or other major defects. Scalable rib cage models will be used to assess the response with age for a variety of frontal and lateral impacts. Data collection will also continue investigating the effects of cumulative head acceleration on Virginia Tech football player performance as a measure of cognitive functional loss from sub-concussive impacts.

"This is work that is sorely needed to accurately represent, in a computer-aided environment, the diversity of human beings for the development of safer vehicle design. The models that are created will be some of the most advanced in computer-aided design for representing the head and chest, the two most frequently injured regions of the body in motor vehicle crashes," said Joel Stitzel, program leader of the CIB and director of the CIB at WFU.

This project will include a total of 25 task areas to be completed over the course of the five years. The three principal investigators, Stitzel from Wake Forest University, Hardy and Stefan Duma, head of SBES, from Virginia Tech, will each be responsible for tasks falling into their individual areas of expertise.

"This project is a perfect example of how we can coordinate the excellent faculty expertise and physical resources within and across campuses in order to compete and win large federal grants. When you look across the U.S. Department of Transportation (US DOT), the Department of Defense (DOD), the National Institutes of Health (NIH), and the National Science Foundation (NSF) funding priorities, this model of collaboration is the clear future of large research groups," says Duma.

It is expected that this approach of continuing research will result in new insight into how to prevent or mitigate injuries in a multitude of at-risk populations, including children and older adults. Risk and epidemiological analysis may be combined with this knowledge to make informed decision about how to effect changes in regulations to improve automotive design and save lives.