**VIRGINIA MILITARY INSTITUTE**
LEXINGTON, VIRGINIA 24450-0304

DEPARTMENT OF MECHANICAL ENGINEERING
Phone 540-464-7308
Fax 540-464-7663
Voice/TDD 540-464-7616

Group Members: Milton E. Aguirre
Bob Downey
Tom Hardinge

**Analysis of Impact Loading on the Human Brain**

The brain is the most important physiological system of the human body. Not only does it allow us to think and problem solve on our own but the brain also plays an irreplaceable role in all of our involuntary movements. Throughout existence, humans have been known to test the physical limits of their body. For instance, every time a football player goes out on the field, he subjects his head to an average of a 13.7 lb impact force during a tackle[*]. In this study, an analysis of the human brain under impact loading will be conducted to help identify root causes of traumatic brain injuries.

In order to meet this project goal a physical testing apparatus will be designed and constructed to obtain actual data by measuring the brain deformations using digital camera advantages. The physical apparatus is designed to use gravity as an accelerator/decelerator for impact application on the brain. This testing will be preformed on a cow brain because it's similarities to the human brain and accessibility.

In addition, a finite element analysis (FEA) will be preformed, in ANSYS, to establish if a FEA is a viable replacement for the physical testing. A 3-D brain geometry mesh will be created, in Gambit, and used to run impact simulations that will match the physical experiment conditions. The brain material for the FEA will be assumed to be an elastic material due to the complexity of equating material properties for a viscoelastic brain.

After all physical tests and FEA simulations were conducted the team came to several conclusions. First, the team concluded that the digital camera used to measure deformations on the actual brain was too low, or slow, on the frames per second (fps) feature. After some research, it is believed a camera having the ability to capture images on the range of 500-1000 fps would produce more accurate results. With this improvement, the physical results would be a much closer match to published data. Furthermore, despite the high percent difference in obtained results, the FEA is proved to be a promising alternative to analyze impact loading on the brain. This indicates that more intricate impact studies on the brain may be conducted computationally to analyze root causes of traumatic brain injuries.

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[*] Response of Human Head Under Static and Dynamic Load using Finite Element Method. http://www.angelfire.com/sd/sbaoi/vol17(2).html. Submitted by S. Sarkar. 2004.

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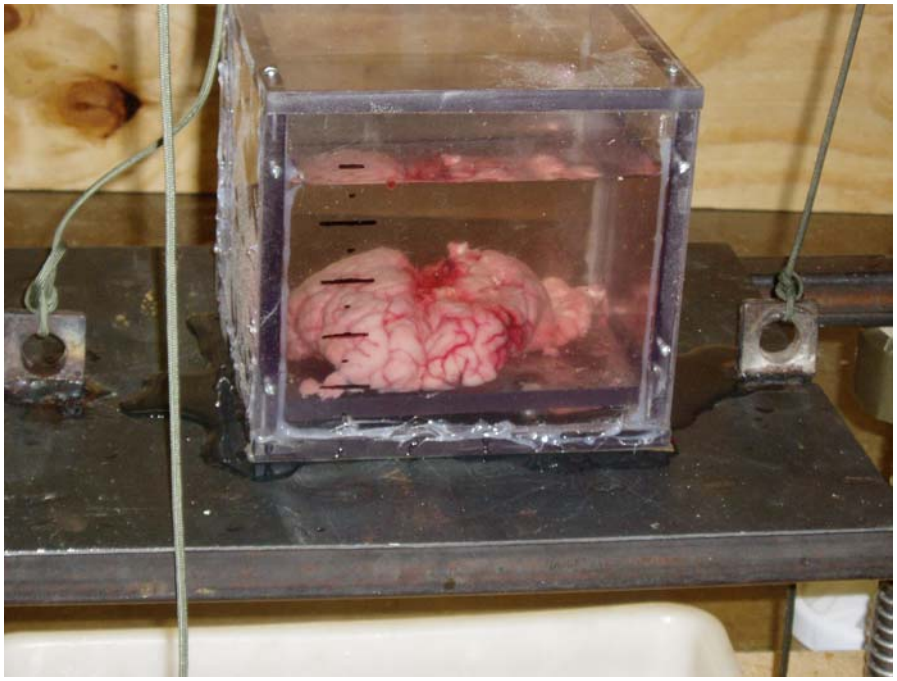
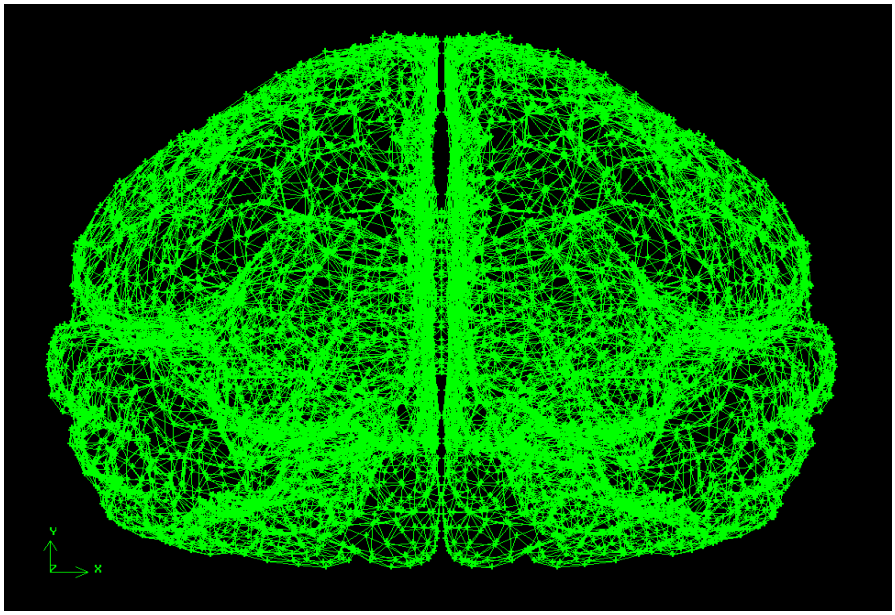


Physical Experimentation




Finite Element Analysis: Brain Geometry