CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)	Project Number
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Project Title

The Effect of Different Impact Absorbing Materials on a Simulated Human Head Model

Abstract

Objectives/Goals

My project was to determine if different impact absorbing materials affect the impact force on a simulated human head model. My hypothesis was that the impact force would be lowered using bubble wrap as an impact absorbing material.

Methods/Materials

Materials: Bubble wrap, Styrofoam, cotton fabric, cardboard. Human head model: iPhone with accelerometer app (Accelerometer Data, Wavefront Labs) inside pencil box. Methods: Gravitational force (G force) was measured, using the accelerometer app, on the iPhone placed inside a pencil box as it was dropped from 0.5M and 1.0M. Five trials from each height, for a total of ten trials, were measured and used as controls. An additional five trials, at each height, were measured for each of four impact absorbing materials surrounding the iPhone, inside the pencil box, for a total of 40 experimental trials. The accelerometer data, from each control and experimental trial, was captured using WiFi and sent to the computer. Mean, standard deviation, ANOVA and student's T-test statistics were applied to the data.

Results

Combining and averaging the data from the two heights, the bubble wrap had the lowest impact force (mean 1.52G) on the simulated human head model and the cardboard had the greatest impact force (mean 2.03G). The overall average impact force of the control was 1.78G. The bubble wrap reduced the overall mean impact force 15% and the cardboard increased the overall mean impact force 14% as compared to the control. The variability of results, as estimated by the standard deviation, ranged from 22-32% of the mean. A one way analysis of variance (ANOVA) showed no statistical difference of impact force in the 0.5M group, but did show a difference in the 1.0M group (p=0.0005). A student's t-test (1.0 M group) determined bubble wrap to have the greatest reduction in impact force on the simulated human head model compared to the other materials.

Conclusions/Discussion

My results showed that different absorbing materials changed the impact force on a human head model. The results also supported my hypothesis that bubble wrap, as an absorbing material, decreased the impact force (15% compared to the control) on the human head model. This data may contribute to the material design of future impact absorbing helmets.

Summary Statement

Different absorbing materials change the impact force on an experimental human head model (iPhone and accelerometer app).

Help Received