CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
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Project Number
S0312

Project Title
Smart Vest: A Novel Approach to Bulletproof Vests

Abstract

Objectives/Goals
The focus of my project is to develop an armor that reduces blunt-force trauma [Goal 1] and supports flexibility [Goal 2] for the wearer without compromising safety.

Methods/Materials
Goal 1: To achieve goal 1, I procured 2 identical Boron Carbide plates-experimental and control. I padded the experimental one with d3o in a staggering pattern and marked each plate with 9 distinct targets of 1" diameter circles. I mounted both plates in a scaffold containing ballistic clay. To test the plates, a city sheriff shot at both plates using 2 different caliber rounds while retaining the same testing conditions. To determine the performance of these plates, both qualitative and quantitative data analysis were performed. As part of qualitative analysis, the back face signature produced in the clay was visually inspected. The quantitative analysis involved comparing and interpreting the roughness of the clay surface's profile for both the plates, where a deeper deformation signifies less dispersion of shockwaves and a higher degree of blunt-force trauma. A homemade profilometer was built to capture X, Y, and Z coordinates of the surface.
Goal 2: To improve the mobility for the user, a design trade space was conducted to arrive at an optimized flexible armor design. A wooden mock up of a final design was built by machining and assembling tessellated tiles. The flexibility of the model was measured through the manipulation of CAD drawings and a protractor.

Results
Goal 1: The analysis of back face signature clearly showed that the control plate's clay had deep and centralized deformations, while the deformations in experimental plate's clay were barely visible. Additionally the quantitative analysis showed that on an average, the experimental plate was able to outperform the control plate by dispersing 57.7% of shockwaves, with 76.4% at best and 26.2% at least.
Goal 2: The resulting design was able to bend 16 degrees in any direction between any two given tiles and was an optimum to support priority movements, commonly observed during combat situations.

Conclusions/Discussion
The results were very promising. With the mere use a non-Newtonian gel to existing plates, I was able to effectively disperse the shockwaves and greatly reduce blunt-force trauma. The flexible design proves that a comfortable armor is possible without compromising the user's security.

Summary Statement
By exploiting the properties of non-Newtonian substances and utilizing an interlocking flexible armor design, a safe, comfortable bulletproof vest is achievable.

Help Received
Mr. Stuart Calhoon guided me through the project; Sergeant Jim Cannan tested plates